# Macroeconomic News Effects and Foreign Exchange Jumps

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## Abstract

This thesis investigates how macroeconomic news announcements affect jumps and cojumps in foreign exchange markets, especially under different business cycles. We use 5-min interval from high frequency data on Euro/Dollar, Pound/Dollar and Yen/Dollar from Nov. 1, 2004 to Feb. 28, 2015. The jump detection method was proposed by Andersen *et al.* (2007c), Lee & Mykland (2008) and then modified by Boudt *et al.* (2011a) for robustness. Then we apply the two-regime smooth transition regression model of Teräsvirta (1994) to explore news effects under different business cycles. We find that scheduled news related to employment, real activity, forward expectations, monetary policy, current account, price and consumption influences forex jumps, but only FOMC Rate Decisions has consistent effects on cojumps. Speeches given by major central bank officials near a crisis also significantly affect jumps and cojumps. However, the impacts of some macroeconomic news are not the same under different economic states.

Key words: *exchange rates, jumps and cojumps, macroeconomic news, smooth transition regression model, crisis*

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# 1. Introduction

For many years, continuous-time diffusion process has formed the basis for asset pricing models. However, researchers of financial markets have noted that there are some large movements in prices that seemingly violate Gaussian assumptions, which motivates analysis of discontinuities, or jumps. Empirical research from Huang & Tauchen (2005) indicates that jumps account for about 4.5% to 7.0% of the total daily variance of the S&P index, cash or futures. The identification of jumps provides a practical motivation for understanding how these discontinuities affect financial markets. For example, Tauchen & Zhou (2011) propose that with reliable identification of jump dynamics, jumps can precisely predict credit risk premia much better than the usual variables such as interest rate and volatility factors. It is assumed that the existence of jumps will significantly influence financial management.

Studying macroeconomic news effects provides an insight into how asset price movements are related to economic fundamentals. Empirical research shows that macroeconomic news affects financial markets. For instance, Andersen *et al.* (2003) find significant news effects with asymmetric response patterns on exchange rate movements. However, we focus on the discontinuous component. Without explicitly modelling the presence of jumps in the pricing process, researchers noted that discontinuities were irregular and depended on market conditions. This lead to studies like, Piazzesi (2003), who finds that incorporating jumps related to market information improves pricing models in bond markets. Moreover, studies of different asset markets incorporating macroeconomic news announcements from various countries find a significant relationship between news and discontinuities (Lahaye *et. al*., 2011; Délèze & Hussain,

2014; Chatrath *et. al.*, 2014). This empirical evidence indicates the power of macroeconomic news' to explain discontinuities.

Recent studies assume that the impact of macroeconomic news may depend on the economic background of the announcement. This is plausible because people tend to make different choices to the same problem under different situations. For example, Veredas (2006) find asymmetric responses to positive and negative news at different phases of the business cycle.

It is worth noting the Institute for Supply Management Survey (ISM) index to determine business cycles provides a more accurate indication of the economy, because it is based on expectations. There are other ways to measure business cycles. Andersen *et al.* (2007) assume that if nonfarm payroll employment declines for three consecutive months, a recession begins. However, Laakkonen & Lanne (2009) use the two-regime Smooth Transition Regression (STR) model from Teräsvirta (1994) to define a business cycle. The advantage of this method is that the threshold of different phases of economy is estimated, and not fixed in advance by any indicators. Rather than identifying the recession period or the expansion period, it concentrates more on the level of the states, so that it can measure more precisely how "good" or "bad" is the economy.

Set against this backdrop, we extract jumps and cojumps from foreign exchange rates (See Andersen *et al.*, 2007c; Lee & Mykland, 2008; Boudt *et al.*, 2011a; Lahaye *et. al.*, 2011), and identify how macroeconomic news influence these discontinuities, especially under different business stages by implementing the STR model. Using 5-min high frequency data on three exchange rates (Euro/Dollar, Pound/Dollar and Yen/Dollar) from Nov. 1, 2004 to Feb. 28, 2015, we take into account both the US crisis and the Euro Zone

crises. Our study provides evidence that scheduled news and speeches related to future monetary policies have significant effects on jumps and cojumps. Especially, for some macroeconomic news announcements, the effects are different depending on the economic states and context. For better measurement of the economic states of the US and Euro Zone crises, we divide our sample into a US subsample and a Euro subsample. We find that more significant scheduled news effects are observed during the expansion period, while more significant unscheduled news and speeches effects are observed during the recession period. With respect to the asymmetric news effects, we find that news has more influence on jumps during expansion periods, indicating that people tend to overreact to the news in good times.

Our study contributes to previous literature in several ways. First, it increases the quantity of news by covering 105 news categories from US, UK, Japan and other major European countries for scheduled news announcements, which implies a more accurate detection of how news announcements characterize jumps. Second, we examine the effects of speeches by important officials in the central banks on forex jumps and cojumps. Third, we check the effects of announcements during the US and Euro Zone crises, in order to see if any news category is sensitive to the crisis. Last but not least, we investigate the asymmetric news effects around the crisis to determine if there is a difference between good news and bad news.

The remainder of our thesis is as follows. Section 2 surveys the relevant literatures. Section 3 explains jump detection and empirical models. Section 4 describes the data set we used in the study. Section 5 analyzes jump characteristics and empirical findings. Section 6 presents the conclusion of our study.

## 2. Literature Review

The relationship between macroeconomic fundamentals and foreign exchange rates has been analyzed for many years. Most early studies start with low-frequency monthly or daily data. For example, in 1988, Hardouvelis use daily data to find how the exchange rate reacts to news about the trade deficit, domestic inflation, and cyclical news which reflects the state of economy. Klein *et al.* (1991) show that news about trade balance has a contingent effect on exchange rates. Kaminsky & Lewis (1996) assert that foreign exchange interventions may work as a signaling device regarding future policy directions. However in some episodes, the exchange rate moves in the opposite direction suggested by the intervention.

More recently, researchers examine the relationship between news announcements and foreign exchange rates movement with intraday high-frequency data. In 2003, Andersen *et al.* use 5-min interval data to study the impact of U.S. and German announcement surprises on the conditional means and variations of currencies during 1992 to 1998. They point out that the response of conditional variance is found to be relatively slow, even if exchange rates react quickly to macro news surprises. They also find that the nature of the response is asymmetric, as adverse news is found to have a larger impact than positive news. Jansen & De Haan (2007) employed the non-parametric sign test to examine the effectiveness of verbal interventions of European Central Bank officials and find that the effects of verbal interventions are small and short-lived. Han (2008) uses high frequency Dollar-Euro foreign exchange returns data to analyze the intraday effects of the US and the EMU (European Monetary Union) macroeconomic news on both the

conditional means and the conditional variances, finding that macroeconomic news have statistically significant effects on exchange rates but appear to be asymmetric.

In addition, there are studies that examine the impact of macroeconomic news on foreign exchange rates under different states of the business cycle. Andersen *et al.* (2007b) study news state dependent effects in several financial markets, to find there is no difference between news effects estimated in full sample compared to subsamples of recession and expansion. Pearce and Solakoglu (2007) use intraday data of DEM/USD (German mark against US dollar) and JPY/USD exchange rates to see if different economic states affect news impacts on returns and volatility. They provide evidence that some news events, such as durable goods orders, non-farm payrolls and trade deficits, are state dependent, indicating these news announcements are sometimes regarded as information of future economic development. But they do not find any significant asymmetries between positive and negative news. However, Fratzscher (2009) provides some evidence that negative news during the financial crisis has induced an appreciation of the US dollar. This suggests that bad news for the US economy may have been perceived as even worse news for other economies, triggering repatriation of capital from other foreign markets and strengthening US dollar. Fatum *et al.* (2012) study how JPY/USD exchange rate reacts to US and Japanese macroeconomic news over different economic conditions and find that the exchange rates respond asymmetrically across different business cycle stages. However they find no significant asymmetric effects of Japanese negative and positive news surprises, but some asymmetric effects of US news surprises. Laakkonen & Lanne (2009) use a two-regime smooth transition regression (STR) model on the high-frequency EUR/USD exchange rate to show that news impacts

are state dependent. They find that the volatility of news, especially negative news, increases more in good times compared to bad times.

Rather than studying how macroeconomic news relates to asset prices in general, we focus on discontinuous price changes, or jumps. Existing papers have concentrated on the jumps of various financial market instruments, such as stock, bond, and exchange rates. Huang & Tauchen (2005) confirm the contribution of jumps by finding that jumps account for 7% of stock price variation. Tauchen & Zhou (2011) also support these findings and further suggest that the identification and estimation of jumps have important implications in assessing financial market risk adjustments. Andersen *et al.* (2007a) confirm the importance of jumps and note that many of the most significant jumps are easily associated with specific macroeconomic news announcements. But jump dynamics are less persistent and predictable than the continuous component. Lahaye *et al.* (2011) identify jumps and cojumps related to macroeconomic news for stock index futures, bond futures, and exchange rates. They find that the probability news announcements cause a jump in exchange rate is only between 1% and 2%, which is less than the 3% to 4% for stocks and bonds. Interestingly, only about 3% to 4% of currency jumps are associated with a particular type of news. The authors posit that jumps in exchange rates are frequent and small because they only consider U.S. macroeconomic news, while ignoring domestic home currency news. More recently, Dewachter *et al.* (2014) use two measures, continuous volatility and discontinuous jumps, to study how exchange rates respond to communication events in the short-term. According to their study on euro-dollar exchange rates, they find that verbal interventions cause large significant jumps for approximately an hour after the news announcement, and these

abnormal variation levels are mostly triggered by the intervention of European officials rather than US authorities.

Macroeconomic news is strongly associated with jumps, and therefore, jump-diffusion processes in asset prices have become more important in recent years. Andersen & Bollerslev (1998), Andersen *et al.* (2001a, 2001b) and Barndorff-Nielsen & Shephard (2002) identify jumps by decomposing realized volatility into a continuous local martingale component and a discontinuous jump martingale component. Barndorff-Nielsen & Shephard (2004, 2006) detect jumps by subtracting realized bi-power variation, which measures the continuous component, from realized volatility, which isolates the jump component. However their method can only detect daily jumps rather than intraday jumps. We use high-frequency data in order to capture the immediate price response to macroeconomic news. Following Andersen *et. al.* (2007c) and Lee & Mykland (2008), we utilize a non-parametric statistic to detect jumps on high frequency data. Then we use the robust periodicity estimation proposed by Boudt *et al.* (2011a) to improve the accuracy of jump detection. In this way, relatively small jumps occurring when volatility is low can be detected while spurious jumps when volatility is high are removed. Inspired by Lahaye *et al.* (2011), we use a jump statistic to construct a cojump dummy and test whether macro announcements cause cojumps across multiple forex markets.

# 3. Methodology

This section begins with the detection strategy of jumps and cojumps, which has been improved by Andersen *et al.* (2007c), Lee & Mykland (2008), and Boudt *et al.* (2011a). We then analyze the impact of macroeconomic fundamentals on jumps and cojumps by using an event study approach and a time-series approach. More importantly, we apply the two-regime smooth transition regression model (STR) to catch these effects during a crisis.

## 3.1 Jump Identification

The origin of the identification of jumps provided by Andersen *et al.* (2007c) and Lee & Mykland (2008) is represented as a continuous time jump-diffusion process

$$dp(t) = \mu(t)dt + \sigma(t)dW(t) + \lambda(t)dq(t), \quad (1)$$

where $p(t)$ is a log asset price; $\mu(t)$ is a continuous and bounded drift term; $\sigma(t)$ is a strictly positive stochastic volatility process; $W(t)$ is a standard Brownian motion, and $q(t)$ is a counting process. Provided the jump exists, $\lambda(t)$ is the size of the corresponding discontinuous jump. The intuition behind this equation is straightforward: If there is no jump, the increment of the standardized instantaneous returns comes from the standard Brownian motion. In other word, since the drift term is close to zero, any standardized returns which are too large to be derived from a standard Brownian motion likely contain jumps.

Assume there are *T* days of *M* equally spaced intraday returns, *M*=[1/Δ], and Δ is the length of unit time period. The test statistic for the presence of jumps in an intraday return $r_{t,i}$ is

$$J_{t,i} \equiv \frac{|r_{t,i}|}{\sigma_{t,i}}, \tag{2}$$

where the *i*th instantaneous return of day *t* is $r_{t,i} \equiv p(t + i\Delta) - p(t + (i-1)\Delta)$, with *i=1,…, M*.

Since $\sigma_{t,i}$ cannot be observed directly, it is estimated by its asymptotic estimator. Barndoff-Nielsen & Shephard (2004) prove that, even in the presence of jumps, realized bipower variation (BPV) can converge into integrated volatility, which can be viewed as a fairly efficient estimator for $\sigma_{t,i}$. Consequently, Andersen *et al.* (2007c) and Lee & Mykland (2008) come up with a scaled BPV over a local window of *K* observations to estimate the volatility. There is a trade-off in choosing the window size *K*. It must be large enough to accurately estimate integrated volatility but small enough for $\sigma_{t,i}$ to be approximately constant. For returns sampled at 5-minute frequency, Lee & Mykland (2008) recommend using K=270 observations.

Under the null of no jumps between *t, i−1* to *t, i*, as $\Delta \to 0$, $J_{t,i}$ (See Eq. (2)) converges to a Gumbel distribution. This is proposed by Lee & Mykland (2008) to minimize the risk of finding false jumps. They obtain jumps if the statistic exceeds a plausible maximum over the sample size. We reject the null of no jump if

$$J_{t,i} > G^{-1}(1-\alpha)S_n + C_n\ , \tag{3}$$

where $G^{-1}(1-\alpha)$ is the $(1-\alpha)$ quantile function of the standard Gumbel distribution, $C_n = (2\log n)^{0.5} - \frac{\log(\pi)+\log(\log n)}{2(2\log n)^{0.5}}$ and $S_n = \frac{1}{(2\log n)^{0.5}}$, $n$ being the total number of observations $(M \times T)$. For instance, if the significant level is $\alpha = 0.1$, we reject the null of no jump if $J_{t,i} > S_n\beta^* + C_n$ with $\beta^*$ such that $\exp(-e^{-\beta^*}) = 1 - \alpha = 0.9$, and $\beta^* = -\log(-\log(0.9)) = 2.25$.

The assumption of Andersen *et al.* (2007c) and Lee & Mykland (2008)'s estimator of the instantaneous volatility is that the volatility must vary slowly during the window of *K* observations. If the length of window length *K* is short, this assumption is realistic, otherwise, it is questionable. 270 observations for *K* is suggested when sampling 5-min frequencies (Lee & Mykland, 2008). Since the $J_{t,i}$ statistic will detect jumps spuriously with cyclical patterns, Boudt *et al.* (2011a) tackle this problem for robust jump detection by assuming that $\sigma_{t,i}$ is the product of an average volatility factor $s_{t,i}$, which is varying slowly, and a deterministic component $f_{t,i}$, which is a function of periodic variables of the same time of the day and the same day of the week. Therefore, we modify the jump statistic to account for the periodic component in the instantaneous volatility,

$$FJ_{t,i} \equiv \frac{|r_{t,i}|}{s_{t,i}f_{t,i}}, \tag{4}$$

with $\int_{t-1}^{t} f^2(s)ds = 1$, which means this deterministic variation process will integrate to one on a daily basis. The estimator of $s_{t,i}$ is obtained from the method proposed by Andersen *et al.* (2007c) and Lee & Mykland (2008) over the local window of *K* observations as mentioned above, $s_{t,i} = \sqrt{\frac{\pi}{2}\frac{1}{K-2}\sum_{j=i-K+2}^{i-1}|r_j||r_{j-1}|}$.

To obtain $f_{t,i}$, Rousseeuw and Leroy (1988) use the shortest half scale (SHS) estimator, and assume that the length of the cycle is one day. To compute the SHS estimator, we first have to standardize the returns with daily BPV, i.e. $\bar{r}_{t,i} = \frac{r_{t,i}}{\sqrt{BPV_t}}$, to compare returns across sample days, where $BPV_t = \frac{\pi}{2}\sum_{i=2}^{M} |r_{t,i}||r_{t,i-1}|$. Let $\bar{r}_{1;t,i}, \dots, \bar{r}_{n_{k,i};t,i}$ (k=1,2,3,4,5 representing Monday to Friday) be the set of standardized returns which share the same periodicity factor as $\bar{r}_{t,i}$. They are all observed at the same time of the day and the same day of the week as $r_{t,i}$. Then, because of the use of SHS, we need to rank the statistics such that $\bar{r}_{(1);t,i} \leq \bar{r}_{(2);t,i} \leq \cdots \leq \bar{r}_{(n_{k,i});t,i}$. The shortest half scale is the smallest length of all 'halves' consisting of $\mathrm{h}_{k,i} = \left\lfloor \frac{n_{k,i}}{2} \right\rfloor + 1$ contiguous order observations. These 'halves' are like $(\bar{r}_{(1);t,i}, \dots, \bar{r}_{(h_{k,i});t,i}), \dots, (\bar{r}_{(n_{k,i}-h_{k,i}+1);t,i}, \dots, \bar{r}_{(n_{k,i});t,i})$, and their length is $\left(\bar{r}_{(h_{k,i});t,i} - \bar{r}_{(1);t,i}\right), \dots, (\bar{r}_{(n_{k,i});t,i} - \bar{r}_{(n_{k,i}-h_{k,i}+1);t,i})$, respectively. The corresponding scale estimator is the minimum lengths of all 'halves': $SH_{t,i} = \Gamma \cdot \min\{\left(\bar{r}_{(h_{k,i});t,i} - \bar{r}_{(1);t,i}\right), \dots, (\bar{r}_{(n_{k,i});t,i} - \bar{r}_{(n_{k,i}-h_{k,i}+1);t,i})\}$, where $\Gamma$ =0.741 is a correction factor to obtain consistency (Rousseeuw & Leroy, 1988). Then, the shortest half estimator for the periodicity factor of $r_{t,i}$ equals

$$\hat{f}_{t,i}^{SH} = \frac{SH_{t,i}}{\sqrt{\frac{1}{M}\sum_{j=1}^{M} SH_{t,j}^2}}$$

However, even though the shortest half estimator is highly robust to jumps, it has only 37% efficiency under normality of $\bar{r}_{t,i}$ (Rousseeuw & Leroy, 1988). Boudt *et al.* (2011a) show that the Weighted Standard Deviation (WSD) estimator is more efficient than the shortest half estimator,

$$\hat{f}_{t,i}^{WSD} = \frac{WSD_{t,i}}{\sqrt{\frac{1}{M}\sum_{j=1}^{M} WSD_{t,j}^2}},$$

where $WSD_{t,j} = \sqrt{\phi \cdot \frac{\sum_{l=1}^{n_{k,j}} I[(\bar{r}_{l;t,j}/\hat{f}_{t,j}^{SH})^2]\bar{r}_{l;t,j}^2}{\sum_{l=1}^{n_j} I[(\bar{r}_{l;t,j}/\hat{f}_{t,j}^{SH})^2]}}$ and $\phi = 1.081$ is a correction factor to obtain consistency (Boudt *et al.*, 2011b). The function $I[\left(\bar{r}_{l;t,j}/\hat{f}_{t,j}^{SH}\right)^2]$ is an indicator function that it equals one when $(\bar{r}_{l;t,j}/\hat{f}_{t,j}^{SH})^2 \leq 6.635$, and it equals zero otherwise. 6.635 is the threshold of the 99% quantile of the $\chi^2(1)$ distribution.

Thus, $FJ_{t,i}$ is used as the test statistic of jumps. We can denote significant jumps as

$$\text{Jump}_{t,i} = r_{t,i} \times I(FJ_{t,i} - G^{-1}(1-\alpha)S_n + C_n)\,, \tag{5}$$

where $I(\cdot)$ is the indicator function. When there is a significant jump, i.e. $FJ_{t,i} > G^{-1}(1-\alpha)S_n + C_n$, it equals one, otherwise it equals zero.

### 3.2 Macro News and Jumps——Event-Study Approach

We follow Dewachter *et al.* (2014) to apply an event-study approach to capture the effects on jumps of news announcements and speeches. Do they trigger jumps in the forex market? To answer this question, we take news announcement or speech as a 5-minute stamp event. Defining the length of the event window is an important issue (Fratzscher, 2005). The length of the window cannot be too long, since a longer time window may have offsetting effects. Following Lahaye *et al.* (2011), we assume that news announcements cause jumps rather than jumps cause news announcements. Therefore, our event-study considers the length of windows from 5-min to 60-min after the event occurrence. In order to see how news announcements and speeches influence jumps, we analyze the jump dynamics after the event in the post-event window.

First, we compute the probability of jump occurrence conditional on the events, which is

$$\mathrm{P(jump|event)} = \frac{\#\ of\ events\ followed\ by\ jumps}{total\ \#\ of\ events}.$$

Further, to compute the unconditional probability, we construct a sub-sample of intraday jumps which excludes the event days. Thus, the unconditional probability of observing jumps becomes

$$\mathrm{P(jump)} = \frac{\#\ of\ jumps\ in\ the\ sub-sample}{\#\ of\ observations\ in\ the\ sub-sample}.$$

Then, we set the null and alternative hypothesis as

$H_0$: P (jump|event) = P (jump),

$H_1$: P (jump|event) ≠ P (jump).

The null hypothesis implies that the conditional probability of a jump caused by an event is identical to the unconditional probability of jump observed on the days without any event. Inspired by Fatum & Hutchison (2003) and Fratzscher (2005), we use a non-parametric binomial test. If the null hypothesis is rejected, it means that events can exert an influence on the jumps.

### 3.3 Macro News Effects on Jumps over Business Cycles

Next we further analyze macroeconomic fundamentals' effects on the jumps during the crisis. We first introduce the two-regime Smooth Transition Regression Model which can define the business cycle more precisely. Then, we discuss how to implement it on the

jumps to see whether macroeconomic fundamentals can influence the probability and the magnitude of jumps under different business cycles.

### 3.3.1 Two-Regime Smooth Transition Regression Model

The US financial crisis started in 2007 with a downturn in the financial market leading to the 2008–2012 global recession and contributing to the Euro Zone crisis in 2009. It prompts us to consider whether there are any different impacts of macroeconomic fundamentals during the crisis. To explore this phenomenon, we apply the two-regime Smooth Transition Regression Model (STR) model introduced by Teräsvirta (1994).

Since global forex markets have different trading times during 24 hours, the 5-min returns exhibit strong intraday periodicity. Therefore, we have to filter out such periodicity before we analyze the effects of news. Andersen & Bollerslev put forward a simple two-step procedure with a flexible fourier form (FFF) model in 1997, which is motivated by Laakkonen (2007) who proved that the FFF method was superior with the smallest bias in the estimated news coefficients.

The method is based on the following procedures:

$$|r_{t,i} - \bar{r}| = \frac{\sigma_t}{\sqrt{M}} \times z_{t,i} \times v_{t,i}$$

where $r_{t,i}$ is the 5-min returns, $\bar{r}$ is the sample mean of the returns, $\sigma_t$ is the daily volatility, $M$ is the number of intraday intervals, $z_{t,i}$ is the intraday volatility, and $v_{t,i}$ is an i.i.d. error term with mean zero and unit variance. The volatility components, such as $\sigma_t$ and $z_{t,i}$, are assumed to be nonnegative. Since the components are unidentifiable, the variables should be isolated by squaring and taking logarithms.

After transformation, we have

$$2\log\frac{|r_{t,i}-\bar{r}|}{\hat{\sigma}_t/\sqrt{M}} = 2\log(z_{t,i}) + 2\log(v_{t,i}) ,$$

where $\hat{\sigma}_t$ is the AR(2)-GARCH(1,1) estimation of $\sigma_t$ following Andersen & Bollerslev (1997). Also, suggested by Andersen & Bollerslev (1997), a parametric representation for $z_{t,i}$ is $z_{t,i} = \hat{z}_{t,i}/\bar{\hat{z}}_{t,i}$. $\bar{\hat{z}}_{t,i}$ is the sample average of $\hat{z}_{t,i}$ for normalization, so that the mean of the periodicity estimate $z_{t,i}$ is equal to one. $\hat{z}_{t,i}$ is obtained from $\hat{z}_{t,i} = \exp(\hat{F}_{t,i}/2)$, where $\hat{F}_{t,i}$ is the fitted value of model

$$F_{t,i} = \alpha + \beta_1 n + \beta_2 n^2 + \sum_{d=1}^{D}\lambda_d I_{d,t,i} + \sum_{p=1}^{P}\left[\delta_{c,p}\cos\left(\frac{2\pi p}{M}n\right) + \delta_{s,p}\sin\left(\frac{2\pi p}{M}n\right)\right] + u_{t,i} \qquad (6)$$

with $F_{t,i} = 2\ln\frac{|r_{t,i}-\bar{r}|}{\hat{\sigma}_t/\sqrt{M}}$. Besides the sinusoids, the model also contains a second order polynomial of intraday interval *n*, the indicator variable $I_{d,t,i}$ which captures intraday calendar effects such as the Japanese lunch effect, and open market effects, US Late summer afternoon effects, and the error term $u_{t,i}$. Divide the original 5-min returns by $z_{t,i}$, and we can obtain the filtered 5-min returns which is $\tilde{r}_{t,i} = r_{t,i}/z_{t,i}$.

It is important to note that the FFF model can only be estimated under the whole sample if the intraday periodicity remains constant over the sample period. However, realistically speaking, this is unlikely. Therefore, following Laakkonen & Lanne (2013), we perform the filtering for each week separately to filter out all the intraday periodicity.

The two-regime smooth transition regression model is:

$$y_{t,i} = \phi_0{}' + \phi_1{}' CN_{t,i} + (\psi_0{}' + \psi_1{}' CN_{t,i})G(t_{t,i}, \gamma, c) + \varepsilon_{t,i}, \qquad (7)$$

with $G(t_{t,i},\gamma,c) = [1+\exp(-\gamma\prod_{v=1}^{V}(t_{t,i}-c_v))]^{-1}$, where $y_{t,i} = 2ln\frac{|\tilde{r}_{t,i}-\bar{r}|}{\hat{\sigma}_t/\sqrt{M}}$ is the measure of volatility, and $CN_{t,i}$ denotes a vector of consolidated macroeconomic news variables. To construct consolidated macroeconomic news variables, we combine all the news together as one vector, assuming that every news announcement has the same influence on exchange rate volatility. Andersen *et al.* (2003) report that the volatility response of the news disappears gradually within two hours. To capture the decaying pattern for the news, we impose a third order polynomial structure on the consolidated news. Transitional function $G(t_{t,i},\gamma,c)$ ranges between zero and one. When $G(t_{t,i},\gamma,c)$ is closer to 0, it means the state is more likely in the recession period, otherwise, when it is closer to 1 means the state is likely in the expansion period. $t_{t,i}$ is the transition variable which indicates the business cycles. We follow Veredas (2006) to choose Institute for Supply Management (ISM) as transition variable for the US crisis because the US ISM manufacturing index is a survey conducted on practitioners from over 300 manufacturing firms to identify the state of economy. However, since the Euro Zone crisis only influenced some Euro Zone countries, especially Italy, Spain, Portugal and Greece, we take the GDP weighed average of 10-year interest rates of these four countries as a transition variable for the Euro Zone crisis. The slope parameter $\gamma$ characterizes the slope of the function. It indicates how quickly one regime transitions to another. For instance, when $\gamma$ is small, the transition is very smooth. The parameter $c_v$ is the threshold of the function to determine when the transition happens, and $v$ is the transition type indicator. Usually, $v$ is assigned as one or two. If $v$=1, this is a logistic STR1 model (LSTR1).

### 3.3.2 Modelling Macro News Effects on Jump Probability with STR

To show how news announcements affect the probability of jumps, we construct a Probit model incorporating the STR model. Our news announcements include four categories: scheduled news, unscheduled news, speeches, and central bank interventions (CBI), which will be explained more specifically in the data section. Bauwens, Ben Omrane & Giot (2005) state the importance of the information that scheduled and unscheduled news contain. The difference between scheduled and unscheduled news is that, for scheduled news, the type and time of the news announcement are known in advance, while, for unscheduled news, such information is unknown. However, both of them can provide information to the public, which will cause reactions in the forex market. Speeches and CBIs, taken as kind of verbal statements, will trigger jumps in the forex markets (Dewachter *et. al.*, 2014), because they are a signaling device for future market direction. First of all, we examine whether these four types of news will trigger jumps under different business cycles:

$$\begin{aligned}&\mathrm{P}\left(\mathrm{Jump}_{t,i}\right) = \Phi\left(\beta_0 + \beta_1 Purenews_{t,i} + \tau_1 Speech_{t,i} + \tau_2 Unsch_{t,i} + \tau_3 CBI_{t,i}\right)\sum_{l=1}^{2} D_l + \\ &\Phi\left(\beta_0' + \beta_1' Purenews_{t,i} + \tau_1' Speech_{t,i} + \tau_2' Unsch_{t,i} + \tau_3' CBI_{t,i}\right)\sum_{l=1}^{2} \hat{G}_l\left(t_{t,i}, \gamma, \mathrm{c}\right) D_l + \\ &\varphi_1 \sum_{i=1}^{4} DW_{t,i} + \delta_1 n_{t,i} + \delta_2 n_{t,i}^2 + \sum_{i=1}^{p}\left(\delta_{2+i}\cos\left[\kappa_{i(t,i)}\right] + \delta_{2+p+i}\sin\left[\kappa_{i(t,i)}\right]\right) + \varepsilon_{t,i}\Big), \qquad (8)\end{aligned}$$

where $\mathrm{P}\left(\mathrm{Jump}_{t,i}\right)$ denotes the probability that a jump occurs. If a jump occurs, $\mathrm{P}\left(\mathrm{Jump}_{t,i}\right) = 1$, otherwise $\mathrm{P}\left(\mathrm{Jump}_{t,i}\right) = 0$. $Purenews_{t,i}$ is the aggregated dummy of the scheduled news. If there is an announcement at an intraday period *t*, *i*, then $Purenews_{t,i}$ equals to one, otherwise it equals to zero. $Speech_{t,i}$ is aggregated dummy variables related to speeches made in the US, Japan, UK and Euro Zone countries by

government and central bank officials such as the US president, the Federal Reserve Chairman and the President of the European Central Bank. If there is a speech announced at an intraday period $t$, $i$, then $Speech_{t,i}$ equals to one, otherwise it equals to zero. $Unsch_{t,i}$ is the dummy variable capturing the unscheduled important news announcements related to crisis. $CBI_{t,i}$ is the aggregated central bank intervention dummy variable. $D_l$ is the indicator function in $l$th subsample. $\hat{G}_l(t_{t,i}, \gamma, c)$ is the fitted value of logistic transition function by using corresponding transition variables. When $D_l$ equals one, it means the subsample begins at the start of the total sample and ends at the end of the US crisis (US subsample). When $D_l$ equals to zero, it means the subsample from the end of the US crisis (European subsample). The interaction term $\hat{G}_l(t_{t,i}, \gamma, c)D_l$ ensures that we only focus on the transition of US economy in the US subsample when $l$=1, and of the European economy in Euro subsample when when $l$=2. $DW_{t,i}$is a linear combination of day-of-the-week dummies. $\delta_1 n_{t,i} + \delta_2 n_{t,i}^2 + \sum_{i=1}^{p}\left(\delta_{2+i}\cos[\kappa_{i(t,i)}] + \delta_{2+p+i}\sin[\kappa_{i(t,i)}]\right)$ represents an intraday periodic component—separate from announcement effects—that is based on a flexible Fourier form, in the spirit of Andersen & Bollerslev (1998), where $n_{t,i}$ takes $M$ (the number of intraday periods within a day) values in {1,...,$M$} according to the intraday position of the index $t$, $i$, $\kappa_{i(t,i)} = 2\pi\frac{1}{M} \times i \times n_{t,i}$, and $p$ is fixed at four terms.

Then we disaggregate the scheduled news announcements and see which scheduled news is likely to trigger jumps. Meanwhile, the other three news categories are kept in aggregated dummies as Eq. (8).

$$\mathrm{P}(\mathrm{Jump}_{t,i}) = \Phi\big(\beta_0 + \sum_{j=1}^{N} \lambda_j |S_{t,i}^{j}| + \tau_1 Speech_{t,i} + \tau_2 Unsch_{t,i} + \tau_3 CBI_{t,i}\big) \sum_{l=1}^{2} D_l +$$

$$\Phi\big(\beta_0' + \sum_{j=1}^{N} \lambda_{t,i}' |S_{t,i}^{j}| + \tau_1' Speech_{t,i} + \tau_2' Unsch_{t,i} + \tau_3' CBI_{t,i}\big) \sum_{l=1}^{2} \hat{G}_l\big(t_{t,i}, \gamma, \mathrm{c}\big) D_l +$$

$$\varphi_1 \sum_{i=1}^{4} DW_{t,i} + \delta_1 n_{t,i} + \delta_2 n_{t,i}^2 + \sum_{i=1}^{p} \big(\delta_{2+i} \cos[\kappa_{i(t,i)}] + \delta_{2+p+i} \sin[\kappa_{i(t,i)}]\big) + \varepsilon_{t,i}\big), \qquad (9)$$

where $\sum_{j=1}^{N} \lambda_j |S_{t,i}^{j}|$ describes the impact of standardized scheduled news surprises. $\lambda$'s are coefficients and $|S_{t,i}^{j}|$ is the standardized surprises magnitudes in market $j$, and $N$ denotes the number of scheduled news announcements. Balduzzi, Elton & Green (2001) propose to measure news surprise by calculating the difference between the forecast and the actual amount, divided by its standard deviation.

Andersen *et. al.* (2003) argue that it is the presence of the news rather than the size of the news surprise that tends to lead volatility. Since 13.82% of news surprises are zero in our sample, we then replace the news surprise, $S_{t,i}^{j}$, by the news dummy, $Purenews_{t,i}^{j}$, to analyze whether the news announcement or the news surprise is more influential on the jumps, Further, we categorize speeches given by different institutions, and replace $S_{t,i}^{j}$ in Eq. (9) by $Speech_{t,i}^{j}$ to see which speech of financial institutions has an impact on forex jumps. Lastly, inspired by the literature on asymmetric effects of news, we classify the news as good news ($Good_{t,i}$) and bad news ($Bad_{t,i}$). When the market forecast of the news is smaller than its announced value, then it is underestimated, and can be defined as positive news. When the market forecast is larger than the announced value of the news, it can be defined as negative news since the news is overestimated. In most cases, positive news is good news and negative news is bad news. However, such generalizations do not hold for all news (For instance, an increase in the unemployment rate is not good news. See Appendix A). Therefore, Eq. (9) becomes

$$\mathrm{P}(\mathrm{Jump}_{t,i}) = \Phi(\beta_0 + \beta_1 Good_{t,i} + \beta_2 Bad_{t,i} + \tau_1 Speech_{t,i} + \tau_2 Unsch_{t,i} + \tau_3 CBI_{t,i}) \sum_{l=1}^{2} D_l +$$
$$\Phi(\beta_0' + \beta_1' Good_{t,i} + \beta_2' Bad_{t,i} + \tau_1' Speech_{t,i} + \tau_2' Unsch_{t,i} + \tau_3' CBI_{t,i}) \sum_{l=1}^{2} \hat{G}_l(t_{t,i}, \gamma, \mathrm{c})\, D_l +$$
$$\varphi_1 \sum_{i=1}^{4} DW_{t,i} + \delta_1 n_{t,i} + \delta_2 n_{t,i}^2 + \sum_{i=1}^{p} (\delta_{2+i} \cos[\kappa_{i(t,i)}] + \delta_{2+p+i} \sin[\kappa_{i(t,i)}]) + \varepsilon_{t,i}) \quad (10)$$

where the other variables are the same as defined in Eq. (9).

### 3.3.3 Modelling Macro News Effects on Jump Magnitude with STR

Besides the probability of jump occurrence, we further analyze the news effects on jump magnitude by using ordinary least square estimation including STR.

$$|Jump_{t,i}| = (\beta_0 + \beta_1 Purenews_{t,i} + \tau_1 Speech_{t,i} + \tau_2 Unsch_{t,i} + \tau_3 CBI_{t,i}) \sum_{l=1}^{2} D_l +$$
$$(\beta_0' + \beta_1' Purenews_{t,i} + \tau_1' Speech_{t,i} + \tau_2' Unsch_{t,i} + \tau_3' CBI_{t,i}) \sum_{l=1}^{2} \hat{G}_l(t_{t,i}, \gamma, \mathrm{c})\, D_l +$$
$$\varphi_1 \sum_{i=1}^{4} DW_{t,i} + \delta_1 n_{t,i} + \delta_2 n_{t,i}^2 + \sum_{i=1}^{p} (\delta_{2+i} \cos[\kappa_{i(t,i)}] + \delta_{2+p+i} \sin[\kappa_{i(t,i)}]) + \varepsilon_{t,i}), \quad (11)$$

where $|Jump_{t,i}|$ is the magnitude (absolute value) of significant observed jumps at period *t*, *i*, and the other variables are the same as those in Eq. (8). In the absence of a jump, $|Jump_{t,i}|$ equals to zero.

Following section 3.3.2, we first disaggregate the news variable to examine which news has an effect on jump magnitude, and then we replace the news surprise by a pure news announcement dummy. Thus, Eq. (9) becomes

$$|Jump_{t,i}| = (\beta_0 + \sum_{j=1}^{N} \lambda_j |S_{t,i}^j| + \tau_1 Speech_{t,i} + \tau_2 Unsch_{t,i} + \tau_3 CBI_{t,i}) \sum_{l=1}^{2} D_l +$$
$$(\beta_0' + \sum_{j=1}^{N} \lambda_{t,i}' |S_{t,i}^j| + \tau_1' Speech_{t,i} + \tau_2' Unsch_{t,i} + \tau_3' CBI_{t,i}) \sum_{l=1}^{2} \hat{G}_l(t_{t,i}, \gamma, \mathrm{c})\, D_l +$$
$$\varphi_1 \sum_{i=1}^{4} DW_{t,i} + \delta_1 n_{t,i} + \delta_2 n_{t,i}^2 + \sum_{i=1}^{p} (\delta_{2+i} \cos[\kappa_{i(t,i)}] + \delta_{2+p+i} \sin[\kappa_{i(t,i)}]) + \varepsilon_{t,i}), \quad (12)$$

Besides disaggregating the news variable, we also disaggregate the speech variable and explore whose speech will lead to a boost in the foreign exchange rate. Then we classify news announcements into good news and bad news, and see whether there are any asymmetric news effects on jump magnitude.

### 3.4 Macro News Effects on Cojumps over Business Cycles

Do jumps in FX markets occur together? This section characterizes cojumps, which are simultaneous jumps in different currencies. Then we will investigate what types of macro news are most likely to affect the cojumps, especially during the crisis.

#### 3.4.1 Cojump Identification

Cojump can be identified when jumps occur in different markets coincidentally. The cojump indicator on a set of $m_n$ forex markets at period *t*, *i* is defined as follows:

$$\text{Cojump}_{t,i}^{m_n} = \prod_{j=1}^{n} I(|Jump_{t,i}^{m_j}|) \tag{13}$$

where $I(\cdot)$ is the indicator function for a positive argument, and $Jump_{t,i}^{m_j}$ refers to significant jumps detected at period *t*, *i* on market $m_j$.

#### 3.4.2 Macro News and Cojump

We use probit estimation with a qualitative indicator for cojumps because there is no unambiguous way to assess the magnitude of cojumps. Therefore, we explore how news announcements affect the occurrence of a cojump:

$$\mathrm{P}\left(Cojump_{t,i}=1\right)=\Phi\left(\beta_0+\beta_1 Purenews_{t,i}+\tau_1 Speech_{t,i}+\tau_2 Unsch_{t,i}+\tau_3 CBI_{t,i}\right)\sum_{l=1}^{2} D_l+$$

$$\Phi\left(\beta_0'+\beta_1' Purenews_{t,i}+\tau_1' Speech_{t,i}+\tau_2' Unsch_{t,i}+\tau_3' CBI_{t,i}\right)\sum_{l=1}^{2}\hat{G}_l\left(t_{t,i},\gamma,\mathrm{c}\right)D_l+$$

$$\varphi_1\sum_{i=1}^{4} DW_{t,i}+\delta_1 n_{t,i}+\delta_2 n_{t,i}^2+\sum_{i=1}^{p}\left(\delta_{2+i}\cos\left[\kappa_{i(t,i)}\right]+\delta_{2+p+i}\sin\left[\kappa_{i(t,i)}\right]\right)+\varepsilon_{t,i}\Big), \qquad (14)$$

where $\Phi(\cdot)$ is the cumulative normal distribution function, and the remaining variables are defined the same as those in Eq. (8).

Likewise, we will disaggregate scheduled news and speech variables successively, and test the asymmetric news effects on cojumps, same as the procedures in modelling jumps. And then we will compare the news effects on the cojumps with those on the jumps to investigate whether there is any consistency or discrepancy.

# 4. Data

Our data set begins from Nov. 1, 2004 and ends at Feb. 28, 2015, during which time the US and European crises take place successively. There are mainly two types of data included: the first type is the macroeconomic news announced by the officials of US, UK, Japan and major European countries including German, France, Italy, Spain, Portugal and Greece, while the other is the intraday 5-minute spot exchange rate returns for Euro/Dollar, Pound/Dollar and Yen/Dollar.

## 4.1 Scheduled News Announcement

The scheduled macroeconomic news announcements are attained from Bloomberg with the date and time. Some news like GDP annualized QoQ (quarter over quarter) Advance for US are announced quarterly, but for the most, it is announced monthly like US Personal Income, US CPI MoM (month over month), and the US unemployment rate, and for a few cases, it is announced weekly such as US Continuing Claims. Since Balduzzi *et al.* (2001) suggest that most of the International Money Market Services (MMS) forecasts are unbiased, we compare the most important US news data from Bloomberg with MMS to verify this and find that almost all the figures are the same.

The news announcement provides us with both actual figures and market forecasts. Since exchange rates reflect future performance, we need the difference between the released value of the announcement and the forecast measured by median of the forecast survey. As in Balduzzi *et al.* (2001), the standardized surprise for announcement *j*, at time *t*, *i*, is calculated as $S_{t,i}^{j} = \frac{A_{t,i}^{j} - F_{t,i}^{j}}{\hat{\sigma}_{j}}$, where $A_{t,i}^{j}$ is the actual figure of announcement *j* at time

$t$, $i$, $F_{t,i}^{j}$ is the forecast of announcement $j$, and $\hat{\sigma}_j$ is the standard deviation of the difference for news $j$. Since the standard deviation $\hat{\sigma}_j$ is constant across all the observations for a given announcement $j$, the standardization does not bias the result. Moreover, this adjustment allows us to compare the size of regression coefficients associated with surprises across different announcements.

### 4.2 Exchange Rate

The high-frequency exchange rate data, from Hotspot FXi, includes tick-by-tick tradable quotes for best bid and best ask spot exchange rates and size. Each quote is time stamped to seconds with three decimals in US Eastern Standard Time (EST), daylight saving time adjusted, starting from 00:00:00.000 EST to 23:59:59.999 EST. Therefore, there are 288 5-minute intervals during the 24-hour foreign exchange market. To minimize the disturbance from outliers and anomalies, the data should also be filtered consistent with conventional treatment as in Andersen & Bollerslev (1998), Bauwen, Ben Omrane & Giot (2005) etc. To deal with the outliers, we remove returns from the first interval for each day because it contains overnight effects, especially for Monday morning. And for the anomalies, we exclude the data on weekends and ten important US statutory holidays[1], and those after 21:00:00.000 on Friday because of their lower quoting activity. After all the filtering, we end up with 681115 return observations for each exchange rate.

[1] The Ten US statutory holidays deleted are: New Year's Day, Martin Luther King's Day, Presidents Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day and Christmas Day.

### 4.3 Additional News Announcement

Besides scheduled news announcements, we also consider the unscheduled news, important speeches and central bank intervention statements.

The unscheduled news data is constructed based on the Financial Turmoil Timeline for both US and European Crises from the Federal Reserve Bank of New York and the European Central Bank, respectively. It is a dummy variable which equals one if there is an unscheduled news announcement related to the crises. Otherwise, it equals to zero.

The speeches are made by important people, such as the president of countries or the officials of the central banks. We obtain this data from Bloomberg Economic Calendar Function (ECF) under the speech category. If there is a speech, the speech dummy is one, otherwise it is zero. We consider it as a 5-min time-stamp event.

The central bank intervention statements are found from the Bank of Japan (BOJ). In addition, there is a wide range of coordinated interventions taken by G-7[2] countries on March 17th, 2011, because of the turbulence aroused by the Japanese Earthquake. To construct intervention data for the Bank of Japan, we create a dummy variable that denotes one during their common opening hours: 9:00 to 15:00 JST and zero otherwise. For the G-7 coordinated intervention, we represent it for the entire operational hours of BOJ (March 17th, 2011 21:00 EST) until the close of the North American foreign exchange market (March 18th, 2011 17:00 EST).

[2] G-7 is a group consisting of the finance ministers and central bank governors of seven major advanced economies as reported by the International Monetary Fund: Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States.

# 5. Results

In this section, we further analyze the characteristics of jumps and cojumps, and their relationships with news announcements. Then, we will describe the business stages measured by the STR model, and compare with the official dates given by NBER and CEPR. Lastly, we will analyze how news announcements affect jumps and cojumps under different business cycles.

## 5.1 Jump Analysis

Figure 1 provides a brief view of the time series of significant jumps. From the figure, it can be seen that, jumps have larger sizes during 2008 to 2010. The increasing jump size shows the market volatility, when the US and Euro Zone crises took place. Among the three exchange rates, the JPY/USD exhibits more volatile jumps with an extremely large jump of -2.87 at 21:30 on October 31st, 2011, which may have been caused by the central bank intervention of Bank of Japan (BOJ) on that day.

Table 1 reports summary statistics of significant jumps for the three foreign exchange rates at 5-min frequencies. For the first panel, it is noticeable that JPY/USD is the most volatile with an annualized standard deviation of 10.89. The number of jump days ranges from 818 in GBP/USD market to 985 in EUR/USD market, accounting for 31.88% to 38.39% of the sample days. In accordance with Lahaye *et. al.* (2011), foreign exchange rate markets have more jump days than other financial markets, such as stock and bond markets, because it has 24 trading hours in a day. Then, looking at the whole sample, only a small proportion of the returns are jumps. For instance, the largest number of jumps is 1464 of JPY/USD, but the percentage of the whole sample is only 0.21%. The

table also shows the average absolute jump size (E(|jumpsize| )) and the related standard deviation (SD(|jumpsize|)). The average absolute jump size is between 0.19 to 0.24, about 8 to 10 times of the mean of the absolute returns (E(|abs(return)|). To analyze whether there is asymmetry in positive and negative jumps, we separate jumps into positive jumps and negative jumps. For all three exchange rates, they have more positive jumps than negative jumps during the sample period, especially for JPY/USD. This phenomenon may be due to the turmoil in financial markets in this period, because a positive jump means US dollar appreciation for the EUR/USD, GBP/USD and JPY/USD. However, comparing the size and standard deviation of positive jumps and negative jumps, we can see that exchange rates displays little asymmetry.

Figure 2 provides a visual view of ump distribution within a day. It presents the jump frequency and mean absolute jump size by time of the day. It is obvious that both the number and the size of jumps are higher around 8:35 and 14:00 to 14:30, corresponding to major macro news announcements, which strongly indicates that forex jumps are related to economic fundamentals. Besides the intraday patterns of jumps, Figure 3 indicates that they also have weekly patterns. For all these three markets, Monday has the fewest jumps, and Wednesday has the most jumps.

In order to draw inferences between jump and news announcement, we identify the top 11 largest jumps for EUR/USD and find that only one of them is not associated with a news announcement. We display the other 10 largest jumps of EUR/USD in Table 2. First of all, we can notice that the largest jumps are matched with at least one news announcement. And when a large jump occurs in one market, it is quite possible that jump also occurs at the same time in other markets, such as the first, second, third, sixth,

seventh and eighth large jump in Table 2. Secondly, it is not only the scheduled news announcements, but also the unscheduled news announcements and speeches are related to the jump occurrence. Therefore, it is meaningful to consider the unscheduled news announcements and speeches in our model. Thirdly, except for one jump in 2005, the other nine jumps all happen during the periods of US financial crisis or the Euro Zone crisis, which motivates us to determine if the crisis impacts the jumps. Lastly, examining the category of the news announcements, we find that the US news related to monetary policy (FOMC Rate Decision, ECB Announces Interest Rate), employment (ADP Employment Change, Unemployment Rate, Continuing Claims, Initial Jobless Claims, Average Hourly Earning MoM Production, and Change in Nonfarm Payrolls), prices (CPI Ex Food and Energy) and current account (Trade Balance) have more potential relevance to the jumps.

Table 3 provides more details about how closely exchange rates jumps match the scheduled news announcement. In total, there are 9866 scheduled news announcements. Some of them are related to the jump occurrence, but some of them are not. The probability of an unconditional announcement is 1.03%, which means 1.03% of intraday intervals have at least one announcement occurrence. To investigate whether news announcement causes jump, we calculate the number of jumps occurring within one hour after the news announcement (# jump-news match). EUR/USD has the most jumps corresponding to news announcements, while GBP/USD has the least number of 247 jumps after matching the news announcements. Next, to see the relationship between jumps and news further, we report the conditional probabilities of jumps and news announcement. P(jump|news) means the probability of a jump conditional on a news

release. From Table 3, we can see that the P(jump|news) ranges from 2.50% to 3.19%, which has little difference among the three exchange rates. P(news|jump) describes how many jumps are associated with news announcement. It ranges from 19.95% to 21.59%, which indicates that 19.95% to 21.59% of forex jumps probably arise from news. The P(jump, news) describes the percentage of jump-news match in the total observations. Among these three exchange rates, the highest P(jump, news) is only 0.046%, not much higher than the lowest probability of 0.036%.

Table 4 describes how exchange rates jumps relate to the speech. There are 4444 speeches in total, much less than the number of scheduled news. Only 0.63% of intraday intervals have at least one speech announced. EUR/USD has the most jumps that occur within one hour after a speech announcement, and only 96 jumps of GBP/USD are related to the announcement of speech. Same as Table 3, we distinguish between P(jump|speech) andP(speech|jump). P(jump|speech) means the probability of a jump if there is a speech, while P(speech|jump) is the percentage of jumps triggered by speech announcement. Comparing with Table 3, P(speech|jump) is only about one third of P(news|jump), implying that more jumps are triggered by the scheduled news.

Table 5 and Table 6 report the results of the event study approach. In Table 5, it is obvious that the probabilities of observing jumps after an announcement (P(jump|event)) are all significantly higher than the probabilities of observing jumps without any announcement (P(jump)) from 5min to 60min window length, which strongly indicates that scheduled news announcement can increase the probability of jump occurrence for these three exchange rates. In Table 6, we can find that, for EUR/USD, the conditional probabilities of observing jumps after speech are all significantly higher than the

unconditional probabilities. For GBP/USD, the conditional probabilities are significantly higher than the unconditional probabilities within the window length of 35min. For JPY/USD, speech effects on jump occurrence can only be detected in the 10min window length. What's more, comparing the P(jump|event) and P(jump) in Table 5 and Table 6, we can find that the difference between P(jump|event) and P(jump) is larger in event window for scheduled news announcement, which suggests that scheduled news has more influence than the speeches.

### 5.2 Cojump Analysis

Figure 4 illustrates at what time of day cojumps usually occur. Comparing cojumps for different exchange rates combinations, it can be easily seen that the greatest spikes tend to occur around 8:35 and between 14:00 to 14:30, when news are often released. This result is coincident with the intraday distribution of jumps as what we discussed above.

Table 7 describes the descriptive characteristics of cojump and its relation to news. Cojump between EUR/USD and GBP/USD has the largest number of 363. And apparently, cojumps on three forex markets is much less frequent than that in two markets. P(coj|jump), the probability of cojumps conditional on individual jumps, examines the markets' interdependence. In Table 7, there are three columns under the panel of P(coj|jump), corresponding to the order of exchange rates shown in the first column. For instance, the first column under P(coj|jump) of 24.88% means that 24.88% of EUR/USD jumps are the cojumps of EUR/USD-GBP/USD. The cojump conditional probability shows that European Union and Great Britain are more interdependent in fundamentals, because a relatively larger proportion of their jumps occur at the same

time. The last two columns in Table 7 relate cojumps to the news announcements. The cojump in three markets has a stronger relation with news than other pairs, and then the cojump pair of EUR/USD-GBP/USD, which indicate that they have larger proportion of cojumps caused by news announcements.

### 5.3 Estimation Results of Logistic Transition Function of STR Model

As mentioned in the methodology, we estimate the transition function for US crisis and Euro Zone crisis by imposing ISM and GDP weighted average long term interest rates as transition variables. Figure 5 plots these two transition variables. It shows that US crisis and Euro crisis do not overlap. Note that a trough (peak) indicates a crisis for ISM (GDP weighted average long term interest rate) respectively. Specifically, for ISM, there is a trough starting in early 2008 and ending in mid-2009, signifying the US crisis. However, for the GDP weighted interest rates, there is a peak starting at the end of 2009, which is the beginning of the Euro Zone crisis.

Table 8 presents the parameter estimates of Eq. (7) for three exchange rates by using ISM and GDP weighted average long term interest rate as transition variables for the US crisis and Euro Zone crisis respectively. The large estimates of the slope parameter $\gamma$ for the transition of the three exchange rates indicate that the transition from one regime to another is abrupt. $\phi_1^{'}$ and $\phi_1^{'} + \psi_1^{'}$ signify the macroeconomic news impact on exchange rate volatility in lower (recession) and higher regimes (expansion), respectively. A statistically significant $\psi_1^{'}$ implies that news effects vary over expansion and recession.

We use two ways to measure the state of economy. One is to use the official NBER and CEPR dates of recession and expansion as a standard measure of the state of the

economy. The other is to use the valued estimated by STR model. Figure 6 plots the business cycle indication function for the US and Euro samples in Panels A and B respectively according to the dates published by NBER (The National Bureau of Economic Research) and CEPR (Centre for Economic Policy Research), along with fitted values of the transition function $G(t_i, \gamma, c)$ estimated by the STR model in EUR/USD in Panels C and D. The difference between these two measurements is that the STR model can identify the level of recession and expansion periods rather than the starting and ending time only.

Comparing Panel A and Panel C in Figure 6, we can notice that the crisis date estimated by the STR model for US starts from January of 2008 to September of 2009, which lags behind the dates published by NBER by a few months. Both Panel B and Panel D describe two recession periods, one in US crisis and one in Euro Zone crisis. The economic states defined by the STR model during Euro Zone crisis looks more volatile than that defined by the dates of CEPR, and the crisis starts and ends earlier and in Panel D. This is plausible because STR model uses more recent data regarding long term interest rates to track the severity of the Euro Zone crisis, compared to CEPR which is based on economic output data.

For better measurement of the US and Euro Zone crises in the model, we divide our sample into two subsamples. Since the dates given by NBER and CEPR are determined, we choose July 1$^{st}$, 2009, the NBER end point of the US crisis, as the dividing point between US and Euro crises. However, according to the results of STR model, we choose to define the US subsample from Nov 1, 2004 to the end of US crisis – Aug 3, 2009, with

the rest as part of the Euro subsample. In the subsequent section, we analyze the macroeconomic news effects on jumps and cojumps within each subsample.

### 5.4 News Effects on Jumps and Cojumps over Business Cycles

Table 9 and Table 10 provide an overall impression about how news is related to the jump probability and jump magnitude, respectively. From Table 9, we can see that scheduled news has the strongest impacts on the probability of jump occurrence. Speeches and unscheduled news also have significant effects on the jumps, but not as strong. Note that CBI has a significant effect on JPY/USD, and most CBIs are released by Bank of Japan. In Table 10, the impact of scheduled news on the jump magnitude is stronger than that of unscheduled news and speeches. Scheduled news exhibits larger effects during the expansion, however, unscheduled news has significant effects during the recession. This is sensible since unscheduled news is usually announced with significant information during difficult times. Next, we investigate how news is related to the cojumps. The results in Table 11 indicate that Euro countries' scheduled news has a significant impact on cojumps. US unscheduled news tends to have significant effects during the recession period in the US subsample.

To extend our research on the news effects, we disaggregate the scheduled news and see which news has effects on jumps and cojumps. Table 12 and Table 13(A, B, C) report the results of disaggregated scheduled news effects on jump probability and jump magnitude. It can be seen that, besides US news, news from German, UK and Euro Zone countries also has significant impacts on the probability of jump. In US news, Change in Nonfarm Payrolls, FOMC News Decision, Initial Jobless Claims, Unemployment Rate,

ISM Manufacturing and Trade Balance exhibit significant effects on jump probability. Besides US news, German news is important to trigger EUR/USD jumps, while UK news is important to GBP/USD jumps. As shown in Table 13(A, B, C), news related to employment, real activity, forward looking, monetary policy, current account, price and consumption has the most influence on jump magnitude. This is consistent with Lahaye *et. al.* (2011) and Délèze & Hussian (2014). For the three exchange rates studied, we find that in the US subsample, news shows significant effects on jump magnitudes mainly during the expansion period, however, in the Euro subsample, more news items show significant effects during the recession period. Some news items exhibit statistically different news effects over recession and expansion periods, such as Change in Nonfarm Payrolls, FOMC Rate Decision, Unemployment Rate, Initial Jobless Claims, Trade Balance and Preliminary Factory Orders WDA YOY for exchange rate EUR/USD. Unlike other news items that have stronger impacts on the jumps during the expansion period, FOMC Rate Decision has larger effects during the recession period, indicating the unique role of interest rate played during the recession period. Investors tend to pay more attention to the credit market when the economy is depressed. Noticeably, the sign of the coefficients of Change in Nonfarm Payrolls and Unemployment Rate changes over different business cycles in the US subsample. In the Euro subsample, the sign of the coefficients of Initial Jobless Claims and Trade Balance changes under different business cycles. Moreover, comparing the STR results to NBER and CEPR estimates, we find that more news items have significant effects during the recession period under the business states defined by NBER dates in the US subsample. Table 14 shows which scheduled news has significant impact on the occurrence of cojumps. In particular, only the FOMC

News Decision, a forward looking news type, has significant effects on all cojumps. In the US subsample, it has larger effects during the recession period, while in Euro subsample, it is larger during the expansion period.

Table 15 and Table 16(A, B, C) investigate the effects of pure news presence on jump probability and jump magnitude. For the three exchange rates studied, the type of the significant news is similar to the news surprise results, but more news of European countries such as Italy, Poland and Spain show significant effects on the jump probability and magnitudes. This may because 66.80% of the zero news surprises are from European news, and their impacts are ignored in the use of news surprise. And more interestingly, under US subsample, news tends to have more significant effects during the expansion period. But in the Euro subsample, pure news tends to have more significant effects during recession period. Comparing the results under the STR business states to NBER or CEPR dates, we find that more news items have significant effects during the recession period in the US subsample by using NBER dates, and less news items have significant effects during the expansion period in the Euro subsample by using CEPR dates. This is consistent with what we find in the news surprise effects on jumps. However, according to Table 17, no significant scheduled news effects on the cojumps are detected, indicating that pure dummy is not as precise as news surprise in measuring new effects.

The test of asymmetric news effects on jump probability and jump magnitude is shown in Table 18 and Table 19. We find slight asymmetry as good news has larger effects on jumps. Comparing the asymetric news effects under different business states, we find that both good news and bad news have state dependent effects, and news has more influence during the expansion period. From Table 20, we can see that bad news has significant

state dependent effects on the cojump pairs EUR/USD-GBP/USD, GBP/USD-JPY/USD and JPY/USD-EUR/USD. However, good news effects on cojumps is indistinguishable over recession or expansion periods, except for EUR/USD-GBP/USD.

We also analyze speech effects on jumps which can be seen in Table 21(A, B, C) and Table 22(A, B, C). Table 21(A, B, C) shows that speeches from the Federal Reserve (Fed), European Central Bank (ECB) and Bank of England (BOE) have significant effects on jump probability. In addition, some important individuals that should be noticeable, such as Ben Shalom Bernanke (chairman of the Fed from 2006 to 2014), Donald Lewis Kohn (Vice Chairman of the Fed from 2006 to 2010), and Jean-Claude Trichet (president of the ECB from 2003 to 2011), who have significant impacts on jump probability for the three exchange rates. For EUR/USD, more speech effects are detected in the Euro subsample, while for GBP/USD, more effects are detected in the US subsample. From Table 22(A, B, C), we notice that more speeches exhibit significant state dependent effects on jump magnitude over different business cycles, and the speakers come from the Fed, ECB, BOE, such as Charles Evans (president and CEO of the Federal Reserve Bank of Chicago from 2007), Timothy Geithner (president of the Federal Reserve Bank of New York from 2003 to 2009), Charles Irving Plosser (president of the Federal Reserve Bank of Philadelphia from 2006 to 2015), Andy Haldane (executive director of financial stability of the BOE from 2009), Charlie Bean (deputy governor for monetary policy at the BOE from 2008 to 2014), Mario Draghi (president of the ECB from 2011) and Lucas Papademos (vice president of the ECB from 2002 to 2010). Their speeches are important because they are key individuals in deciding monetary policy, especially around the crisis. Moreover, we also find that speeches from

the Fed usually have significant effects in the US subsample, while speeches from BOE and ECB usually have significant effects in the Euro subsample. Like unscheduled news which is not announced regularly, speeches have more effects during the recession period. This is plausible because monetary measures are usually taken in difficult times to protect the economy. Table 23 describes how speeches influence cojumps under different states. We can see that significant speeches are fewer than that for jumps. This is plausible since significant speeches have to exert impacts on more than one exchange rate for cojumps.

## 6. Conclusion

Our objective is to identify forex jumps and cojumps and to investigate how macroeconomic news is related to these discontinuities under different business cycles. We use 5-min high frequency data on three exchange rates (Euro/Dollar, Pound/Dollar and Yen/Dollar) from Nov. 1, 2004 to Feb. 28, 2015, during which the US crisis and the Euro Zone crisis take place successively. Even though there is some literature about jumps and cojumps in financial markets, to our knowledge, no one has considered their reactions to macroeconomic news during different business cycles.

The jump detection measure we use was proposed by Andersen *et al.* (2007c), Lee & Mykland (2008), and modified by Boudt *et al.* (2011a) to remove any periodic patterns for robustness. More importantly, we apply the two-regime smooth transition regression model (STR), as well as NBER and CEPR indicators, to catch the effects under recession and expansion periods. First, we find that jumps are related to economic fundamentals, even though jumps are only a small proportion of the sample. Scheduled news announcements and speeches have significant effects on jumps, but scheduled news is more influential because it is announced more frequently than speeches. Secondly, scheduled news announcements related to employment, real activity, forward looking news, monetary policy, current account, price and consumption have significant effects on jumps. FOMC Rate Decision shows consistent effects on cojumps, which indicate the importance of the news about future monetary policy. Investors tend to pay more attention to the credit market when the economy is depressed. Thirdly, macroeconomic news effects on jumps depend on the state of economy. More scheduled news items have significant effects during the expansion period under the US subsample, while under the

Euro subsample, the number of significant news items increases during the recession period. For the unscheduled news and speeches, more significant effects are detected during the recession period, because they tend to be released in difficult times to protect the economy. Notably, the sign of the coefficients of Change in Nonfarm Payrolls, Initial Jobless Claims, Trade Balance, and Unemployment Rate switches between recession and expansion periods. Fourthly, Comparing good and bad news effects under different business cycles, we find that news has more influence during the expansion period, indicating that people may overvalue news in good times. Lastly, speeches from Federal Reserve, European Central Bank, Bank of England have significant effects on the jumps. These speakers play a very important role in making monetary policies, especially around the crisis.

These results have practical implications for finance practitioners and researchers that macroeconomic news announcements do impact forex jumps and cojumps. Apart from studying how the market responds to different types of news, we should also consider the economic states in which the news was announced.

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# Tables

**Table 1 Descriptive Statistics on Significant Jumps**

| | EUR/USD | GBP/USD | JPY/USD |
|---|---|---|---|
| # obs. | 681115 | 681115 | 681115 |
| E(\|abs(return)\|) | 0.02 | 0.02 | 0.03 |
| Annualized SD | 9.90 | 9.92 | 10.89 |
| # days | 2566 | 2566 | 2566 |
| # jump days | 985 | 818 | 943 |
| P (jump day) (%) | 38.39 | 31.88 | 36.75 |
| E(#jump\|jump day) | 1.48 | 1.43 | 1.55 |
| # jumps | 1459 | 1169 | 1464 |
| P(jump) (%) | 0.21 | 0.17 | 0.21 |
| E(\|jumpsize\|) | 0.20 | 0.19 | 0.24 |
| SD($\|jumpsize\|$) | 0.12 | 0.13 | 0.18 |
| # jump>0 | 757 | 595 | 820 |
| P (jump>0) (%) | 0.11 | 0.09 | 0.12 |
| E(jumpsize\|jump>0) | 0.20 | 0.19 | 0.25 |
| SD($jumpsize\|jump > 0$) | 0.12 | 0.12 | 0.18 |
| # jump<0 | 702 | 574 | 644 |
| P (jump<0) (%) | 0.10 | 0.08 | 0.09 |
| E(jumpsize\|jump<0) | -0.20 | -0.21 | -0.24 |
| SD($jumpsize\|jump < 0$) | 0.11 | 0.14 | 0.19 |
| % of negative jump | 48.12 | 49.10 | 43.99 |
| SD | 1.31 | 1.46 | 1.30 |

Notes: The table displays six panels. The first panel has the number of observations (# obs.), absolute value of the return ($E(|abs(return)|)$), annualized standard deviation of intraday returns (Annualized SD), the number of sample days (# days). The second panel has the total number of days with at least one jump (# jump days), the probability of a jump day ( $\mathrm{P}(\text{jump day}) = 100 * (\#\text{ jump days}/\#\text{ days})$ ), and the number of jumps per jump day ($\mathrm{E}(\#\text{jump}|\text{jump day}) = \#\text{ jumps}/\#\text{ jump days}$). In panel three, we provide the total number of jumps (# jumps), the percentage of jumps (P(jump)=100*(# jumps/#obs.)), the absolute mean jump size ($\mathrm{E}(|\text{jumpsize}|)$), and their standard deviation (SD($|jumpsize|$)). In the next two panels, the jumps are split into two sets, positive jumps and negative jumps. The last panel reports the percentage of negative jumps ($100 * (\#\text{ jumps} < 0/\#\text{ jumps})$), and the associated standard error (100*$\sqrt{\frac{(1-\#\ jumps<0/\#\ jumps)*(\#\ jumps<0/\#\ jumps)}{\#\ jumps}}$).

**Table 2 Largest EUR/USD Jumps Matched with News**

| Time | Country | News | Surprise | EUR/USD | GBP/USD | JPY/USD |
|---|---|---|---|---|---|---|
| 2009/03/18 14:20:00 | US | FOMC Rate Decision | 0.00 | 1.13 | 0.62 | 1.36 |
| | US | Unscheduled | | | | |
| 2011/11/30 08:05:00 | US | ADP Employment Change | 1.26 | 1.08 | 0.52 | 0.51 |
| | | Coordinated Central Bank Intervention | | | | |
| 2009/03/25 10:00:00 | US | New Home Sales | 0.64 | 1.02 | 0.82 | 0.85 |
| 2013/11/07 07:50:00 | EC | ECB Announces Interest Rate | -4.73 | -0.99 | | |
| | EC | Unscheduled | | | | |
| | EC | Trade Balance SA | 1.71 | 0.81 | | |
| 2008/12/18 04:50:00 | UK | Retail Sales Ex Auto MoM | 1.11 | | | |
| | UK | Retail Sales Ex Auto YoY | 0.49 | | | |
| | EC | Unscheduled | | | | |
| 2005/01/12 08:35:00 | US | Trade Balance | -1.75 | 0.76 | 0.58 | 0.74 |
| | US | Speech (Fed) | | | | |
| | US | Speech (Fed) | | | | |
| 2015/02/06 08:35:00 | US | CPI Ex Food and Energy | 0.45 | -0.76 | -0.46 | -0.89 |
| | US | Trade Balance | 0.64 | | | |
| 2008/12/16 14:25:00 | US | FOMC Rate Decision | -5.84 | 0.71 | | 0.59 |
| | US | Unscheduled | | | | |
| 2008/01/04 08:35:00 | US | Avg Hourly Earning MoM prod | 0.84 | 0.70 | | |
| | US | Change in Nonfarm Payrolls | -0.79 | | | |
| | US | Unemployment Rate | 1.27 | | | |
| | US | Continuing Claims | 3.41 | -0.67 | | |
| | US | Initial Jobless Claims | 0.62 | | | |
| 2011/05/05 08:35:00 | EC | Speech (Trichet) | | | | |
| | UK | Speech (BOE) | | | | |
| | EC | Unscheduled | | | | |

Notes: The first column is the news announcement time. The second column is the country of the news: US-United States, UK-United Kingdoms; EC-Euro Zone Countries. The third column is the type of the statements. The statements reported are announced 15-min before and after the jump occurrence. Speech denotes the speeches with the source in the parentheses. Unscheduled denotes the unscheduled news. The forth column is the value of news surprise. The sixth to the eighth column are the jump size of EUR/USD, GBP/USD and JPY/USD respectively.

**Table 3 Descriptive Statistics on Jump and News**

| | EUR/USD | GBP/USD | JPY/USD |
|---|---|---|---|
| # obs. | 681115 | 681115 | 681115 |
| # days | 2566 | 2566 | 2566 |
| # news | 9866 | 9866 | 9866 |
| # news days | 2374 | 2374 | 2374 |
| P (news) (%) | 1.03 | 1.03 | 1.03 |
| # jumps | 1459 | 1169 | 1464 |
| # jump-news match | 315 | 247 | 292 |
| P (jump\|news) (%) | 3.19 | 2.50 | 2.96 |
| P (news\|jump) (%) | 21.59 | 21.13 | 19.95 |
| P (jump,news) (%) | 0.046 | 0.036 | 0.043 |

Notes: From the top to the bottom, the table displays the number of observations (# obs.), the number of sample days (# days), the number of scheduled news announcements (# news), the number of days with at least one news announcement (# news days), the probability that at least one announcement occurs in an interval (P(news)), the number of jumps (# jumps), the number of jumps occurring within one hour after announcement (# jump-news match), the probability of a jump conditional on a release (P(jump|news)=100*(# jump-news match/# news)), the probability of an announcement given a jump (P(news|jump)=100*(# jump-news match/# jumps)), the probability of a jump-news match (P(jump,news)=100*(# jump-news match/# obs.)).

**Table 4 Descriptive Statistics on Jump and Speech**

| | EUR/USD | GBP/USD | JPY/USD |
|---|---|---|---|
| # obs. | 681115 | 681115 | 681115 |
| # days | 2566 | 2566 | 2566 |
| # speech | 4444 | 4444 | 4444 |
| # speech days | 1788 | 1788 | 1788 |
| P (speech) (%) | 0.63 | 0.63 | 0.63 |
| # jumps | 1459 | 1169 | 1464 |
| # jump-speech match | 146 | 96 | 101 |
| P (jump\|speech) (%) | 3.29 | 2.16 | 2.27 |
| P (speech\|jump) (%) | 10.00 | 8.21 | 6.90 |
| P (jump,speech) (%) | 0.021 | 0.014 | 0.015 |

Notes: From the top to the bottom, the table displays the number of observations (# obs.), the number of sample days (# days), the number of speeches (# speech), the number of days with at least one speech announced (# speech days), the probability that at least one speech occurs in an interval (P(speech)), the number of jumps (# jumps), the number of jumps occurring within one hour after speech announced (# jump-speech match), the probability of a jump conditional on a speech announced (P(jump|speech)=100*(# jump-speech match/# speeches)), the probability of a speech announcement given a jump (P(speech|jump)=100*(# jump-speech match/# jumps)), the probability of a jump-speech match (P(jump,speech)=100*(# jump-speech match/# obs.)).

**Table 5 Post-event Windows of Jumps and Scheduled News**

| Panel A: EUR/USD | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Event Window | 5min | 10min | 15min | 20min | 25min | 30min | 35min | 40min | 45min | 50min | 55min | 60min |
| Matching Number | 125 | 147 | 177 | 192 | 208 | 229 | 238 | 250 | 267 | 279 | 295 | 313 |
| P (jump\|conditional) (%) | 1.77 | 2.09 | 2.51 | 2.73 | 2.95 | 3.25 | 3.38 | 3.55 | 3.79 | 3.96 | 4.19 | 4.44 |
| P (jump\|unconditional) (%) | 0.22 | 0.44 | 0.66 | 0.88 | 1.10 | 1.32 | 1.54 | 1.76 | 1.98 | 2.19 | 2.41 | 2.63 |
| p-value | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Panel B: GBP/USD | | | | | | | | | | | | |
| Event Window | 5min | 10min | 15min | 20min | 25min | 30min | 35min | 40min | 45min | 50min | 55min | 60min |
| Matching Number | 99 | 118 | 136 | 146 | 151 | 173 | 183 | 195 | 212 | 220 | 227 | 240 |
| P (jump\|conditional) (%) | 1.41 | 1.68 | 1.93 | 2.07 | 2.14 | 2.46 | 2.60 | 2.77 | 3.01 | 3.12 | 3.22 | 3.41 |
| P (jump\|unconditional) (%) | 0.16 | 0.32 | 0.47 | 0.63 | 0.79 | 0.95 | 1.11 | 1.27 | 1.42 | 1.58 | 1.74 | 1.90 |
| p-value | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Panel C: JPY/USD | | | | | | | | | | | | |
| Event Window | 5min | 10min | 15min | 20min | 25min | 30min | 35min | 40min | 45min | 50min | 55min | 60min |
| Matching Number | 88 | 109 | 140 | 159 | 178 | 198 | 210 | 225 | 239 | 255 | 269 | 281 |
| P (jump\|conditional) (%) | 1.25 | 1.55 | 1.99 | 2.26 | 2.53 | 2.81 | 2.98 | 3.19 | 3.39 | 3.62 | 3.82 | 3.99 |
| P (jump\|unconditional) (%) | 0.18 | 0.36 | 0.53 | 0.71 | 0.89 | 1.07 | 1.25 | 1.42 | 1.60 | 1.78 | 1.96 | 2.14 |
| p-value | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Note: Panel A, B, C show the EUR/USD jump dynamics, GBP/USD jump dynamics and JPY/USD jump dynamics after the news announcements respectively. Event window shows the length of the window. Matching number is the number of news followed by the jumps corresponding to the window length. P (jump|conditional) (%) is the probability of observing jumps conditional on the events. P (jump|unconditional) (%) is the probability of observing jumps in the sample without events. P-value signifies whether P (jump|conditional) and P (jump|unconditional) are different.

**Table 6 Post-event Windows of Jumps and Speech**

| Panel A: EUR/USD | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Event Window | 5min | 10min | 15min | 20min | 25min | 30min | 35min | 40min | 45min | 50min | 55min | 60min |
| Matching Number | 34 | 46 | 59 | 72 | 80 | 94 | 101 | 113 | 121 | 132 | 134 | 143 |
| P (jump\|conditional) (%) | 0.80 | 1.08 | 1.38 | 1.69 | 1.88 | 2.21 | 2.37 | 2.65 | 2.84 | 3.10 | 3.14 | 3.36 |
| P (jump\|unconditional) (%) | 0.23 | 0.46 | 0.69 | 0.92 | 1.15 | 1.38 | 1.61 | 1.84 | 2.07 | 2.30 | 2.53 | 2.76 |
| p-value | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 |
| Panel B: GBP/USD | | | | | | | | | | | | |
| Event Window | 5min | 10min | 15min | 20min | 25min | 30min | 35min | 40min | 45min | 50min | 55min | 60min |
| Matching Number | 21 | 26 | 35 | 45 | 53 | 62 | 69 | 74 | 76 | 85 | 88 | 95 |
| P (jump\|conditional) (%) | 0.49 | 0.61 | 0.82 | 1.06 | 1.24 | 1.45 | 1.62 | 1.74 | 1.78 | 1.99 | 2.06 | 2.23 |
| P (jump\|unconditional) (%) | 0.19 | 0.38 | 0.57 | 0.77 | 0.96 | 1.15 | 1.34 | 1.53 | 1.72 | 1.92 | 2.11 | 2.30 |
| p-value | 0.00 | 0.02 | 0.02 | 0.02 | 0.04 | 0.04 | 0.07 | 0.15 | 0.39 | 0.38 | 0.45 | 0.40 |
| Panel C: JPY/USD | | | | | | | | | | | | |
| Event Window | 5min | 10min | 15min | 20min | 25min | 30min | 35min | 40min | 45min | 50min | 55min | 60min |
| Matching Number | 19 | 26 | 33 | 37 | 44 | 58 | 61 | 67 | 70 | 78 | 86 | 96 |
| P (jump\|conditional) (%) | 0.45 | 0.61 | 0.77 | 0.87 | 1.03 | 1.36 | 1.43 | 1.57 | 1.64 | 1.83 | 2.02 | 2.25 |
| P (jump\|unconditional) (%) | 0.22 | 0.45 | 0.67 | 0.90 | 1.12 | 1.34 | 1.57 | 1.79 | 2.01 | 2.24 | 2.46 | 2.69 |
| p-value | 0.00 | 0.08 | 0.23 | 0.46 | 0.33 | 0.47 | 0.26 | 0.16 | 0.05 | 0.04 | 0.03 | 0.04 |

Notes: Panel A, B, C show the EUR/USD jump dynamics, GBP/USD jump dynamics and JPY/USD jump dynamics after the speeches respectively. Event window shows the length of the window. Matching number is the number of speeches followed by the jumps corresponding to the window length. P (jump|conditional) (%) is the probability of observing jumps conditional on the events. P (jump|unconditional) (%) is the probability of observing jumps in the sample without events. P-value signifies whether P (jump|conditional) and P (jump|unconditional) are different.

**Table 7 Descriptive Statistics on Cojump and News**

| | #obs. | # coj | P (coj) (%) | P (coj\|jump) (%) | | | # Co-News | P (news\|coj) (%) |
|---|---|---|---|---|---|---|---|---|
| | | | | EUR | GBP | JPY | | |
| EUR-GBP | 681115 | 363 | 0.053 | 24.88 | 31.05 | | 35 | 9.64 |
| GBP-JPY | 681115 | 137 | 0.020 | | 11.72 | 9.36 | 16 | 11.68 |
| JPY-EUR | 681115 | 194 | 0.028 | 13.30 | | 13.25 | 23 | 11.86 |
| EUR-GBP-JPY | 681115 | 97 | 0.014 | 6.65 | 8.30 | 6.63 | 13 | 13.40 |

Notes: The first column is the number of observations (# obs.). The second column is the number of cojumps (# coj). The third column is the probability of cojumps (P (coj)). The forth to the sixth columns are the probability of a cojump conditional on a considered market designated in the second row. For instance, 25.57% of EUR/USD jumps are the cojumps of EUR/USD and GBP/USD markets. The seventh column is the number of cojumps matched with contemporaneous news announcements (# Co-News). The last column is the percentage of cojumps given by news announcements (P (news|coj) =100*(# Co-News/# coj)).

**Table 8: Estimation of STR Model**

| | ISM | | | WGDP | | |
|---|---|---|---|---|---|---|
| | EUR/USD | GBP/USD | JPY/USD | EUR/USD | GBP/USD | JPY/USD |
| $\gamma$ | 116.394 | 93.598 | 113.3190 | 33326.10 | 17152.35 | 342686.6 |
| $\phi_0'$ | -0.225*** | -0.076*** | -0.220*** | -0.346*** | -0.187*** | -0.328*** |
| $\phi_1'$ | 22.874*** | 13.301*** | 26.398*** | 36.274*** | 26.862*** | 52.251*** |
| $\psi_0'$ | -0.078*** | -0.085*** | -0.074*** | 0.082*** | 0.061*** | 0.065*** |
| $\psi_1'$ | 5.434*** | 9.327*** | 10.667*** | -13.819*** | -9.087*** | -25.786*** |
| LSTR Type | LSTR1 | LSTR1 | LSTR1 | LSTR1 | LSTR1 | LSTR1 |
| $c_k$ | -4.451 | -4.118 | -4.389 | -0.484*** | -0.423*** | -0.498*** |

Notes: This table shows the parameter estimations in Eq. (7) by using ISM and GDP weighted average long term interest rate as transition variable respectively. ISM (Institute of Supply Management) is manufacturing index surveyed from over 300 manufacturing firms to identify the state of economy. WGDP is GDP weighted average long term interest rate of four Euro countries: Italy, Spain, Portugal and Greece. These countries are largely affected by Euro Zone crisis. *** indicates significance at 1% level.

**Table 9 News Effects on Jump Probability**

| News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | STR | | | NBER | | | STR | | | CEPR | | |
| | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD Jump | | | | | | | | | | | | |
| US News | -3.2290 | 0.4950*** | 0.1080 | 0.7254*** | 0.1861 | 0.3319 | -0.0882 | 0.3290* | 0.0953 | | | |
| EC News | 0.6245*** | 0.8062*** | 0.0002 | 0.4488*** | 0.9029*** | 0.0000 | 0.7004*** | 0.9003*** | 0.0409 | 0.8447*** | 0.6230*** | 0.0000 |
| EC Unscheduled | | | | | | | 0.0029 | 0.2948*** | 0.0047 | | | |
| Speech | 0.2674 | 0.2524* | 0.5170 | 0.2530 | 0.2575* | 0.4594 | 0.2500** | 0.3708*** | 0.1120 | 0.2988*** | 0.3150* | 0.3759 |
| Panel B: GBP/USD Jump | | | | | | | | | | | | |
| US News | 0.2788 | 0.5338*** | 0.0621 | 0.4072* | 0.5323*** | 0.0462 | 0.6265*** | 0.7576*** | 0.0045 | 0.6874*** | 0.6649*** | 0.0736 |
| EC News | 0.4211 | 0.7809*** | 0.0003 | 0.4246** | 0.8255** | 0.0000 | 0.4588** | 0.7812** | 0.0002 | 0.6911*** | 0.3506* | 0.9811 |
| US Unscheduled | 0.1643*** | 0.0341 | 0.5440 | 0.1865*** | 0.1321 | 0.9210 | | | | | | |
| Panel C: JPY/USD Jump | | | | | | | | | | | | |
| EC News | 0.4693** | 0.4757*** | 0.1423 | 0.6633*** | 0.3227** | 0.9589 | 0.6721*** | 0.9322*** | 0.0009 | 0.7402*** | 0.7805*** | 0.0016 |
| US Unscheduled | 0.0745 | 0.2140*** | 0.0109 | 0.1558*** | 0.2422** | 0.1256 | | | | | | |
| EC Unscheduled | | | | 0.1631* | -0.1001 | 0.3310 | 0.0653* | -0.0672 | 0.5319 | | | |
| CBI | | | | | | | | | | 0.7396*** | 0.0400 | 0.3344 |

Notes: The table shows aggregated news effects on jump probability over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUR/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. US news and EC news represent aggregated news of US and European countries respectively. US Unscheduled and EC Unscheduled represent unscheduled news of US and European countries respectively. Speech represents aggregated speech announcements. CBI represents aggregated central bank interventions. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 10 News Effects on Jump Magnitude**

| News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | STR | | | NBER | | | STR | | | CEPR | | |
| | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD Jump | | | | | | | | | | | | |
| US News | -0.0011 | 0.0019*** | 0.0000 | 0.0037*** | 0.0000 | 0.0000 | | | | | | |
| EC News | 0.0065*** | 0.0061*** | 0.0000 | 0.0041*** | 0.0077*** | 0.0000 | 0.0047*** | 0.0070*** | 0.0037 | 0.0062*** | 0.0038*** | 0.0000 |
| US Unscheduled | 0.0002** | 0.0000 | 0.5527 | 0.0002*** | -0.0001 | 0.4457 | | | | | | |
| EC Unscheduled | -0.0001 | 0.0004* | 0.0000 | 0.0003* | -0.0004 | 0.0719 | 0.0001 | 0.0006** | 0.0257 | | | |
| Speech | 0.0001 | 0.0012*** | 0.0394 | 0.0003 | 0.0014*** | 0.0185 | 0.0007*** | 0.0012*** | 0.0224 | 0.0007*** | 0.0012*** | 0.0000 |
| Panel B: GBP/USD Jump | | | | | | | | | | | | |
| US News | 0.0003 | 0.0024*** | 0.0000 | 0.0006 | 0.0027*** | 0.0000 | 0.0039*** | 0.0062*** | 0.0000 | 0.0050*** | 0.0038*** | 0.0008 |
| EC News | 0.0018*** | 0.0034*** | 0.0000 | 0.0020*** | 0.0038*** | 0.0000 | 0.0013*** | 0.0033*** | 0.0000 | 0.0026*** | 0.0008** | 0.1841 |
| US Unscheduled | 0.0003*** | 0.0001 | 0.3085 | 0.0004*** | 0.0001 | 0.6555 | | | | | | |
| Speech | -0.0007 | 0.0008*** | 0.0164 | -0.0006 | 0.0011*** | 0.0019 | | | | | | |
| CBI | | | | | | | | | | 0.0011** | -0.0003 | 0.2382 |
| Panel C: JPY/USD Jump | | | | | | | | | | | | |
| EC News | 0.0057*** | 0.0016*** | 0.0223 | 0.0057*** | 0.0008* | 0.0001 | 0.0043*** | 0.0066*** | 0.0000 | 0.0045*** | 0.0055*** | 0.0000 |
| US Unscheduled | 0.0003** | 0.0007*** | 0.0000 | 0.0005*** | 0.0005** | 0.2221 | | | | | | |
| EC Unscheduled | 0.0010*** | 0.0002 | 0.3483 | 0.0010*** | -0.0002 | 0.0513 | | | | | | |
| Speech | | | | | | | | | | | | |
| CBI | | | | | | | | | | 0.0146*** | -0.0001 | 0.0000 |

Notes: The table shows aggregated news effects on jump probability over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUR/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. US news and EC news represent aggregated news of US and European countries respectively. US Unscheduled and EC Unscheduled represent unscheduled news of US and European countries respectively. Speech represents aggregated speech announcements. CBI represents aggregated central bank interventions. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 11 News Effects on Cojump**

| News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | STR | | | NBER | | | STR | | | CEPR | | |
| | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD-GBP/USD Cojump | | | | | | | | | | | | |
| EC News | 0.7287*** | 0.8914*** | 0.0019 | 0.5952** | 0.9508*** | 0.0000 | 0.8158*** | 1.1264** | 0.0000 | 0.9603*** | 0.8329*** | 0.0900 |
| US Unscheduled | | | | 0.1802** | -0.2914 | 0.2218 | | | | | | |
| Panel B: GBP/USD-JPY/USD Cojump | | | | | | | | | | | | |
| EC News | 0.7603** | 0.5797*** | 0.4736 | 0.6824** | 0.6159*** | 0.3219 | 0.7399*** | 1.2697*** | 0.0000 | 1.0091*** | 0.8733*** | 0.1391 |
| Panel C: JPY/USD-EUR/USD Cojump | | | | | | | | | | | | |
| EC News | 1.0895** | 0.7169*** | 0.4204 | 0.9094** | 0.7657*** | 0.1451 | 0.8988*** | 1.2408*** | 0.0000 | 1.0605*** | 0.9669*** | 0.0230 |
| US Unscheduled | | | | 0.2859** | -0.0199 | 0.5342 | | | | | | |
| Panel D: EUR/USD-GBP/USD-JPY/USD Cojump | | | | | | | | | | | | |
| EC News | 1.1429*** | 0.6501*** | 0.0505 | 1.0277*** | 0.6741*** | 0.0617 | 0.8386*** | 1.2454*** | 0.0004 | 1.0034*** | 1.0209*** | 0.0232 |

Notes: The table shows aggregated news effects on cojumps over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUR/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. EC news represents aggregated news of European countries. US Unscheduled represents unscheduled news of US. Speech represents aggregated speech announcements. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 12 Scheduled News Effects on Jump Probability**

| Country | News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD Jump | | | | | | | | | | | | | |
| US | Change in Nonfarm Payrolls | -0.3038 | 1.3547*** | 0.0007 | 0.2263 | 1.2722*** | 0.0015 | | | | | | |
| US | FOMC Rate Decision | 2.4977*** | 2.1403*** | 0.0092 | 2.1042*** | 2.2724*** | 0.0003 | 2.0502*** | 2.3663** | 0.0003 | 1.9578*** | 2.4854*** | 0.0000 |
| US | Initial Jobless Claims | | | | | | | 0.4531** | 0.1459 | 0.5578 | -0.0033 | 0.5875*** | 0.0909 |
| US | Unemployment Rate | 1.5252** | 0.4141 | 0.4793 | 0.6885* | 0.6358 | 0.5574 | 0.3325 | 1.0884** | 0.1117 | | | |
| GE | Factory Orders WDA YOY-Prel | -15.5488 | 0.7465*** | 0.2393 | | | | 0.9170* | 1.7975*** | 0.0408 | | | |
| GE | IFO Business Climate | -20.2572 | 1.4634*** | 0.9897 | 1.6799*** | 0.9220*** | 0.7894 | | | | | | |
| GE | Retail Sales MoM | -13.6619 | 0.7941*** | 0.9919 | | | | | | | | | |
| EC | CPI Estimate YoY | | | | | | | 0.6513*** | 1.1251*** | 0.0181 | | | |
| | EC Unscheduled | | | | | | | 0.0067 | 0.2754*** | 0.0102 | | | |
| | Speech | 0.2780 | 0.3036** | 0.3709 | 0.2739 | 0.3089** | 0.5632 | 0.2529** | 0.4360*** | 0.0442 | 0.3668*** | 0.2971 | 0.0766 |
| Panel B: GBP/USD Jump | | | | | | | | | | | | | |
| US | Change in Nonfarm Payrolls | | | | | | | 0.9614** | 0.8173 | 0.8734 | | | |
| US | FOMC Rate Decision | 2.1132*** | 2.1563*** | 0.0018 | 1.8095*** | 2.2827*** | 0.0001 | 1.9367*** | 2.0757*** | 0.0424 | 1.9256*** | 2.1054*** | 0.0043 |
| UK | GDP QoQ-Advance | | | | | | | 1.4520*** | 1.9591*** | 0.3179 | 1.7416*** | 1.3417*** | 0.2423 |
| UK | Retail Sales Ex Auto MoM | | | | | | | -2.3244 | 2.3032** | 0.1116 | 3.4147** | -4.1868 | 0.0523 |
| UK | Retail Sales Ex Auto YoY | | | | | | | 2.3738** | -1.0932 | 0.0132 | -2.5863 | 3.8838** | 0.0050 |
| | US Unscheduled | 0.1458** | 0.0283 | 0.5706 | 0.1752*** | 0.1054 | 0.8800 | | | | | | |
| Panel C: JPY/USD Jump | | | | | | | | | | | | | |
| US | ADP Employment Change | | | | | | | | | | 1.3216*** | 2.1054*** | 0.0146 |
| US | Change in Nonfarm Payrolls | | | | | | | | | | 1.3051*** | 0.9270* | 0.6130 |
| US | FOMC Rate Decision | 2.1322*** | 1.5831*** | 0.0088 | 2.1034*** | 1.4631*** | 0.3248 | 2.2261*** | 2.3274*** | 0.0070 | 2.1927*** | 2.3799*** | 0.0005 |
| US | ISM Manufacturing | | | | | | | | | | 0.7761** | 1.1095*** | 0.0818 |
| US | Retail Sales Ex Auto MoM | | | | 0.4631 | 0.8532*** | 0.0775 | | | | | | |
| US | Trade Balance | | | | 0.4889 | 1.0826*** | 0.0555 | | | | | | |
| US | Unemployment Rate | | | | | | | | | | 0.6417* | 0.2208 | 0.8508 |
| | US Unscheduled | 0.0729 | 0.2186*** | 0.0076 | 0.1466*** | 0.2429** | 0.1142 | | | | | | |
| | EC Unscheduled | | | | 0.1709* | -0.1011 | 0.3198 | 0.0687* | -0.0668 | 0.5265 | | | |

Notes: The table shows disaggregated scheduled news effects on jump probability over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUR/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. Speech represents aggregated speech announcements. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the scheduled news: US-United States; GE-Germany; EC-Euro Zone countries; UK-United Kingdoms. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 13A Scheduled News Effects on Jump Magnitude (*Exchange Rate: EUR/USD*)**

| Country | News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | ADP Employment Change | | | | | | | 0.0233*** | -0.0008 | 0.0011 | 0.0424*** | -0.0003 | 0.0000 |
| US | CPI Ex Food and Energy MoM | -0.0004 | 0.0080*** | 0.0001 | 0.0134*** | -0.0017 | 0.0001 | -0.0022 | 0.0062** | 0.0050 | 0.0040** | -0.0012 | 0.1974 |
| US | Change in Nonfarm Payrolls | -0.0540*** | 0.0942*** | 0.0000 | 0.0056* | 0.0972*** | 0.0000 | 0.0217*** | 0.0068** | 0.0000 | 0.0356*** | -0.0003 | 0.0000 |
| US | Consumer Confidence Index | -0.0003 | 0.0094*** | 0.0001 | -0.0003 | 0.0118*** | 0.0000 | | | | | | |
| US | FOMC Rate Decision | 0.2302*** | 0.0598*** | 0.0000 | 0.1415*** | 0.0724*** | 0.0000 | 0.1002*** | 0.1356*** | 0.0004 | 0.0929*** | 0.1421*** | 0.0000 |
| US | Housing Starts | | | | | | | -0.0023 | 0.0291*** | 0.0000 | 0.0127*** | 0.0022 | 0.3549 |
| US | ISM Manufacturing | -0.0003 | 0.0039** | 0.0903 | -0.0003 | 0.0045** | 0.0456 | 0.0064*** | -0.0001 | 0.1090 | 0.0068*** | -0.0001 | 0.1676 |
| US | Industrial Production MoM | -0.0003 | 0.0092*** | 0.0000 | -0.0003 | 0.0120*** | 0.0000 | | | | | | |
| US | Initial Jobless Claims | | | | | | | 0.0119*** | -0.0040*** | 0.0000 | -0.0014 | 0.0211*** | 0.0000 |
| US | PPI Ex Food and Energy MoM | -0.0002 | 0.0133*** | 0.0001 | 0.0002 | 0.0126*** | 0.0000 | | | | | | |
| US | PPI MoM | 0.0001 | -0.0141*** | 0.0000 | 0.0001 | -0.0132*** | 0.0000 | -0.0059** | 0.0033 | 0.5737 | -0.0019 | -0.0064** | 0.0719 |
| US | Retail Sales Ex Auto MoM | -0.0003 | 0.0223*** | 0.0000 | -0.0003 | 0.0267*** | 0.0000 | -0.0006 | 0.0083*** | 0.0021 | 0.0069*** | -0.0006 | 0.1166 |
| US | Trade Balance | -0.0003 | 0.0783*** | 0.0000 | -0.0004 | 0.1005*** | 0.0000 | -0.0041*** | 0.0127*** | 0.0000 | 0.0020 | -0.0070*** | 0.0002 |
| US | Unemployment Rate | 0.1192*** | -0.0241*** | 0.0000 | 0.0280*** | -0.0296*** | 0.0000 | 0.0099*** | 0.0571*** | 0.0000 | 0.0292*** | -0.0001 | 0.0001 |
| GE | Factory Orders WDA YOY-Prel | -0.0003 | 0.0135*** | 0.0059 | 0.0202*** | -0.0002 | 0.0000 | 0.0044** | 0.0086** | 0.0976 | 0.0103*** | -0.0004 | 0.0882 |
| GE | IFO Business Climate | -0.0003 | 0.0537*** | 0.0000 | 0.0826*** | 0.0167*** | 0.0000 | -0.0020 | 0.0123*** | 0.0001 | 0.0033* | -0.0001 | 0.4197 |
| GE | Retail Sales MoM | -0.0003 | 0.0086*** | 0.0001 | 0.0239*** | -0.0002 | 0.0000 | | | | | | |
| UK | Visible Trade Balance GBP/Mn | -0.0005 | 0.0053** | 0.1042 | -0.0004 | 0.0055** | 0.0940 | | | | | | |
| IT | Retail Sales MoM | | | | | | | 0.0079*** | -0.0004 | 0.0619 | 0.0072*** | -0.0003 | 0.1330 |
| EC | CPI Estimate YoY | | | | | | | 0.0065*** | 0.0292*** | 0.0047 | 0.0167*** | -0.0002 | 0.0407 |
| EC | Retail Sales MoM | -0.0004 | 0.0035** | 0.1372 | -0.0003 | 0.0046** | 0.0518 | | | | | | |
| | US Unscheduled | | | | 0.0002** | -0.0001 | 0.3770 | | | | | | |
| | EC Unscheduled | 0.0000 | 0.0004** | 0.0594 | 0.0003* | -0.0003 | 0.0962 | 0.0001 | 0.0005** | 0.0322 | | | |
| | Speech | 0.0004 | 0.0012*** | 0.0783 | 0.0004 | 0.0012*** | 0.0543 | 0.0007** | 0.0012*** | 0.0247 | 0.0007 | 0.0011*** | 0.0039 |

Notes: The table shows disaggregated scheduled news effects on EUR/USD (Euro/Dollar) jump magnitude over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. US Unscheduled represents unscheduled news of US. Speech represents aggregated speech announcements. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the scheduled news: US-United States; GE-Germany; EC-Euro Zone countries; UK-United Kingdoms; IT-Italy. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 13B Scheduled News Effects on Jump Magnitude (*Exchange Rate: GBP/USD*)**

| Country | News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | ADP Employment Change | | | | | | | 0.0053*** | 0.0189*** | 0.0000 | 0.0148*** | -0.0002 | 0.0002 |
| US | Change in Nonfarm Payrolls | 0.0001 | 0.0106*** | 0.0001 | -0.0264*** | 0.0346*** | 0.0000 | 0.0234*** | 0.0303*** | 0.0049 | 0.0558*** | -0.0001 | 0.0000 |
| US | Consumer Confidence Index | -0.0002 | 0.0110*** | 0.0000 | -0.0002 | 0.0137*** | 0.0000 | | | | | | |
| US | FOMC Rate Decision | 0.1095*** | 0.0541*** | 0.0000 | 0.0672*** | 0.0654*** | 0.0000 | 0.0551*** | 0.0668*** | 0.0000 | 0.0572*** | 0.0615*** | 0.0000 |
| US | ISM Manufacturing | -0.0003 | 0.0043** | 0.0460 | -0.0003 | 0.0050*** | 0.0202 | | | | | | |
| US | Industrial Production MoM | -0.0003 | 0.0082*** | 0.0003 | -0.0003 | 0.0108*** | 0.0000 | | | | | | |
| US | PPI Ex Food and Energy MoM | -0.0002 | 0.0151*** | 0.0000 | -0.0002 | 0.0145*** | 0.0000 | | | | | | |
| US | PPI MoM | -0.0002 | -0.0142*** | 0.0000 | -0.0001 | -0.0129*** | 0.0000 | | | | | | |
| US | Retail Sales Ex Auto MoM | -0.0002 | 0.0204*** | 0.0000 | -0.0001 | 0.0239*** | 0.0000 | | | | | | |
| US | Trade Balance | -0.0003 | 0.0632*** | 0.0000 | -0.0002 | 0.0813*** | 0.0000 | 0.0040*** | -0.0033* | 0.0226 | | | |
| US | Unemployment Rate | -0.0003 | 0.0549*** | 0.0000 | 0.0691*** | -0.0212*** | 0.0000 | 0.0021 | 0.0610*** | 0.0000 | 0.0192*** | -0.0001 | 0.0000 |
| GE | IFO Business Climate | -0.0003 | 0.0096*** | 0.0000 | 0.0197*** | -0.0003 | 0.0000 | | | | | | |
| FR | Consumer Spending MoM | | | | | | | 0.0149*** | -0.0002 | 0.0002 | 0.0205*** | -0.0001 | 0.0000 |
| UK | Bank of England Bank Rate | -0.0001 | 0.1358*** | 0.0000 | -0.0001 | 0.2038*** | 0.0000 | | | | | | |
| UK | CPI MoM | | | | | | | -0.0006 | 0.0388*** | 0.0000 | 0.0377*** | 0.0000 | 0.0000 |
| UK | GDP QoQ-Advance | | | | | | | 0.1028*** | 0.1868*** | 0.0000 | 0.0908*** | 0.1128*** | 0.0000 |
| UK | Industrial Production MoM | | | | | | | 0.0118*** | 0.0240*** | 0.0003 | 0.0363*** | -0.0002 | 0.0000 |
| UK | Nationwide House Px MoM | 0.0161*** | -0.0002 | 0.0000 | 0.0131*** | -0.0002 | 0.0025 | | | | | | |
| UK | Retail Sales Ex Auto YoY | -0.0002 | 0.0444*** | 0.0000 | -0.0001 | 0.0330*** | 0.0000 | 0.0395*** | -0.0717*** | 0.0000 | -0.0775*** | 0.0698*** | 0.0000 |
| | US Unscheduled | 0.0003*** | 0.0001 | 0.7071 | 0.0004*** | 0.0001 | 0.7174 | | | | | | |
| | Speech | -0.0006 | 0.0008** | 0.0043 | -0.0005 | 0.0010** | 0.0042 | | | | | | |
| | CBI | | | | | | | | | | 0.0011** | -0.0002 | 0.2554 |

Notes: The table shows disaggregated scheduled news effects on GBP/USD (Pound/Dollar) jump magnitude over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. US Unscheduled represents unscheduled news of US. Speech represents aggregated speech announcements. CBI represents aggregated central bank interventions. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the scheduled news: US-United States; GE-Germany; FR-France; UK-United Kingdoms. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 13C Scheduled News Effects on Jump Magnitude (*Exchange Rate: JPY/USD*)**

| Country | News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | ADP Employment Change | -0.0004 | 0.0127*** | 0.0018 | 0.0077*** | -0.0004 | 0.2687 | 0.0742*** | 0.0876*** | 0.0000 | 0.0225*** | 0.1263*** | 0.0000 |
| US | Change in Nonfarm Payrolls | | | | | | | 0.1004*** | 0.0769*** | 0.0000 | 0.1273*** | 0.0512*** | 0.0011 |
| US | FOMC Rate Decision | 0.2221*** | 0.0203*** | 0.0000 | 0.1513*** | 0.0166*** | 0.0000 | 0.1051*** | 0.1096*** | 0.0000 | 0.0995*** | 0.1188*** | 0.0000 |
| US | Factory Orders | | | | | | | 0.0063** | -0.0048 | 0.0000 | 0.0093*** | -0.0021 | 0.0209 |
| US | GDP Annualized QoQ-Advance | -0.0004 | 0.0259*** | 0.0001 | 0.0337*** | -0.0005 | 0.0036 | 0.0620*** | 0.0022 | 0.0000 | 0.0998*** | -0.0003 | 0.0004 |
| US | ISM Manufacturing | | | | | | | 0.0097*** | 0.0234*** | 0.0000 | 0.0103*** | 0.0221*** | 0.0000 |
| US | Initial Jobless Claims | -0.0007 | 0.0073*** | 0.0014 | 0.0103*** | -0.0003 | 0.0001 | | | | | | |
| US | New Home Sales | -0.0010 | 0.0056*** | 0.3262 | -0.0007 | 0.0059*** | 0.0418 | | | | | | |
| US | PPI Ex Food and Energy MoM | -0.0542*** | 0.0011 | 0.0000 | -0.0201*** | -0.0016 | 0.0157 | 0.0085** | -0.0001 | 0.8093 | 0.0091** | 0.0019 | 0.1139 |
| US | PPI MoM | 0.0511*** | -0.0056** | 0.0000 | 0.0176*** | -0.0023 | 0.0009 | -0.0070* | -0.0003 | 0.0404 | -0.0038 | -0.0129*** | 0.1807 |
| US | Pending Home Sales MoM | | | | | | | -0.0013 | 0.0224*** | 0.0220 | -0.0004 | 0.0085*** | 0.0009 |
| US | Philadelphia Fed Business Outlook | -0.0005 | 0.0055** | 0.0415 | -0.0005 | 0.0076*** | 0.0113 | 0.0188*** | -0.0003 | 0.0000 | 0.0124*** | 0.0219*** | 0.0000 |
| US | Retail Sales Ex Auto MoM | 0.0076*** | 0.0167*** | 0.0000 | 0.0046** | 0.0214*** | 0.0000 | 0.0134*** | -0.0001 | 0.0000 | 0.0177*** | 0.0005 | 0.0001 |
| US | Trade Balance | 0.0165*** | 0.0489*** | 0.0000 | 0.0104*** | 0.0637*** | 0.0000 | | | | | | |
| US | Unemployment Rate | | | | | | | -0.0007 | 0.0552*** | 0.0000 | 0.0201*** | 0.0093*** | 0.8296 |
| UK | Retail Sales Ex Auto MoM | -0.0007 | 0.0192*** | 0.0242 | 0.0209** | -0.0001 | 0.2737 | | | | | | |
| JP | Housing Starts YoY | | | | | | | -0.0006 | 0.0202*** | 0.0023 | | | |
| | US Unscheduled | 0.0002* | 0.0007*** | 0.0000 | 0.0004*** | 0.0005** | 0.2448 | | | | | | |
| | EC Unscheduled | 0.0010*** | 0.0002 | 0.2417 | 0.0010*** | -0.0002 | 0.0409 | | | | | | |
| | Speech | | | | -0.0008* | 0.0002 | 0.1464 | | | | | | |
| | CBI | | | | | | | | | | 0.0146*** | -0.0001 | 0.0000 |

Notes: The table shows disaggregated scheduled news effects on JPY/USD (Yen/Dollar) jump magnitude over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. US Unscheduled and EC Unscheduled represent unscheduled news of US and European countries respectively. Speech represents aggregated speech announcements. CBI represents aggregated central bank interventions. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the scheduled news: US-United States; UK- United Kingdoms; JP-Japan. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 14 Scheduled News Effects on Cojump**

| Country | News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD-GBP/USD Cojump | | | | | | | | | | | | | |
| US | FOMC Rate Decision | 2.5620*** | 2.1673*** | 0.0193 | 2.2763*** | 2.2647*** | 0.0025 | 2.3055*** | 2.6274*** | 0.0003 | 2.3221*** | 2.5893*** | 0.0004 |
| | US Unscheduled | | | | 0.1721* | -0.4351 | 0.1641 | | | | | | |
| Panel B: GBP/USD-JPY/USD Cojump | | | | | | | | | | | | | |
| US | FOMC Rate Decision | 2.3691*** | 1.6812*** | 0.0155 | 2.1813*** | 1.7378*** | 0.0212 | 2.2675*** | 2.5749*** | 0.0015 | 2.2913*** | 2.4910*** | 0.0021 |
| Panel C: JPY/USD-EUR/USD Cojump | | | | | | | | | | | | | |
| US | FOMC Rate Decision | 2.9724*** | 1.9255*** | 0.0193 | 2.5252*** | 2.0075*** | 0.0825 | 2.4774*** | 2.9059 | 0.0000 | 2.4827*** | 2.8505*** | 0.0004 |
| | US Unscheduled | | | | 0.2464* | -0.0305 | 0.5942 | | | | | | |
| | Speech | | | | | | | 0.4435** | 0.3843 | 0.6175 | 0.3846* | 0.3846* | |
| Panel D: EUR/USD-GBP/USD-JPY/USD Cojump | | | | | | | | | | | | | |
| US | FOMC Rate Decision | 2.9448*** | 1.7650*** | 0.0043 | 2.5265*** | 1.7948*** | 0.0064 | 2.3662*** | 2.6398*** | 0.0000 | 2.3730*** | 2.6407*** | 0.0010 |

Notes: The table shows disaggregated scheduled news effects on cojumps over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUR/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. US Unscheduled represents unscheduled news of US. Speech represents aggregated speech announcements. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the scheduled news: US-United States. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 15 Pure News Effects on Jump Probability**

| Country | News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD Jump | | | | | | | | | | | | | |
| US | CPI Ex Food and Energy MoM | -2.7420 | 0.9406** | 0.9939 | | | | | | | | | |
| US | Core PCE QoQ | | | | | | | 0.8316** | 1.2455** | 0.1151 | | | |
| US | Durables Ex Transportation | -2.5570 | 1.9331*** | 0.0076 | 2.2999*** | 1.4170*** | 0.4856 | | | | | | |
| GE | Industrial Production SA MoM-Prel | 2.4980*** | 2.1401*** | 0.0092 | 2.1056*** | 2.2729*** | 0.0003 | 2.0494*** | 2.3671*** | 0.0003 | 1.9580*** | 2.4850*** | 0.0002 |
| GE | Unemployment Rate | | | | 1.2210** | 0.9057** | 0.5561 | | | | | | |
| GE | ZEW Survey Current Situation | 1.2978** | 1.7601*** | 0.0012 | 1.1691** | 1.8426*** | 0.0002 | | | | | | |
| PO | CPI MoM | | | | | | | 1.2700** | 1.7415*** | 0.0832 | 1.3072*** | 1.6927*** | 0.1065 |
| EC | Industrial New Orders SA MoM | | | | | | | 0.9081** | 1.9426*** | 0.0002 | | | |
| | EC Unscheduled | | | | | | | 0.0057 | 0.2899*** | 0.0060 | | | |
| | Speech | | | | | | | 0.2620** | 0.3852*** | 0.1123 | 0.3674*** | 0.3152* | 0.4928 |
| Panel B: GBP/USD Jump | | | | | | | | | | | | | |
| US | PPI MoM | | | | | | | 1.5160*** | 1.2866*** | 0.2819 | 1.2494*** | 1.6648*** | 0.0101 |
| US | Pending Home Sales MoM | | | | | | | 0.9137** | 1.5412*** | 0.0118 | 1.1795*** | 1.2633*** | 0.1695 |
| US | Unemployment Rate | | | | | | | 2.0991*** | 1.8530*** | 0.1938 | 1.7675*** | 2.3292*** | 0.0059 |
| GE | Industrial Production SA MoM-prel | 2.1132*** | 2.1563*** | 0.0046 | 1.8051*** | 2.2810*** | 0.0001 | 1.7565 | 3.9691*** | 0.0414 | 1.9248*** | 2.1061*** | 0.0032 |
| GE | ZEW Survey Current Situation | | | | 1.2238** | 0.8557** | 0.6211 | | | | | | |
| UK | Nationwide House Px MoM | | | | | | | 1.4479*** | 2.1432 | 0.0371 | | | |
| | US Unscheduled | 0.1458** | 0.0283 | 0.5706 | 0.1805*** | 0.1178 | 0.8166 | | | | | | |
| Panel C: JPY/USD Jump | | | | | | | | | | | | | |
| GE | Construction Investment QoQ | | | | | | | 1.4672*** | 1.5554*** | 0.0406 | 1.3426*** | 1.7799*** | 0.0022 |
| GE | Industrial Production SA MoM-Prel | 2.1419*** | 1.5834*** | 0.1991 | 2.1013*** | 1.4610*** | 0.3239 | 2.2286*** | 2.3332*** | 0.0064 | 2.1887*** | 2.3817*** | 0.0006 |
| UK | CPI Core YoY | | | | | | | | | | 0.8430** | 1.2109*** | 0.1170 |
| UK | CPI MoM | | | | | | | | | | 1.0509*** | 0.8392 | 0.6047 |
| IT | Business Confidence | | | | | | | 0.8527** | 1.3036*** | 0.0878 | 0.8734** | 1.2639*** | 0.1003 |
| | US Unscheduled | 0.0638 | 0.2126*** | 0.0095 | 0.1464*** | 0.2411** | 0.1178 | | | | | | |
| | CBI | | | | | | | | | | 0.7381*** | 0.0446 | 0.3414 |

Notes: The table shows pure scheduled news effects on jump probability over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUR/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the scheduled news: US-United States; EC-Euro Zone countries; GE-Germany; UK-United Kingdoms; PO- Portugal; IT-Italy. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 16A Pure News Effects on Jump Magnitude (*Exchange Rate: EUR/USD*)**

| Country | News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | CPI Ex Food and Energy MoM | -0.0004 | 0.0066*** | 0.0039 | 0.0174*** | -0.0003 | 0.0002 | | | | | | |
| US | Chicago Purchasing Manager | | | | | | | -0.0003 | 0.0092*** | 0.0015 | 0.0029* | -0.0003 | 0.8080 |
| US | Core PCE QoQ-Advance | -0.0004 | 0.0067*** | 0.3537 | 0.0156*** | -0.0003 | 0.0005 | 0.0033** | 0.0035 | 0.4610 | 0.0053*** | -0.0004 | 0.2164 |
| US | Durables Ex Transportation | -0.0003 | 0.0505*** | 0.0000 | 0.0874*** | 0.0159*** | 0.0000 | -0.0016 | 0.0060** | 0.0065 | | | |
| US | GDP Annualized QoQ-Prel | -0.0004 | 0.0119*** | 0.0040 | -0.0003 | 0.0167*** | 0.0000 | | | | | | |
| US | ISM Manufacturing | | | | | | | 0.0042*** | -0.0008 | 0.3018 | 0.0042** | -0.0003 | 0.1838 |
| US | Philadelphia Fed Business Outlook | -0.0003 | 0.0030* | 0.1761 | -0.0003 | 0.0038** | 0.0859 | | | | | | |
| US | Retail Sales Ex Auto MoM | | | | | | | -0.0003 | 0.0050** | 0.0333 | | | |
| GE | Construction Investment QoQ | | | | | | | 0.0198*** | -0.0006 | 0.1169 | 0.0208*** | -0.0005 | 0.0000 |
| GE | Exports QoQ | | | | | | | -0.0008 | 0.0465*** | 0.0000 | 0.0151*** | -0.0011 | 0.0357 |
| GE | GDP SA QoQ-Prel | | | | | | | -0.0008 | 0.0205*** | 0.0000 | 0.0093*** | -0.0012 | 0.0129 |
| GE | IFO Business Climate | -0.0003 | 0.0048*** | 0.0458 | -0.0010 | 0.0065*** | 0.0027 | | | | | | |
| GE | Industrial Production SA MoM-Prel | 0.2302*** | 0.0598*** | 0.0000 | 0.1415*** | 0.0724*** | 0.5476 | 0.1002*** | 0.1356*** | 0.0005 | 0.0929*** | 0.1421*** | 0.0000 |
| GE | Unemployment Rate | -0.0001 | 0.0151*** | 0.0000 | 0.0157*** | 0.0099*** | 0.4200 | -0.0016 | 0.0086*** | 0.0002 | 0.0033** | -0.0004 | 0.4131 |
| GE | ZEW Survey Current Situation | 0.0528*** | 0.0817*** | 0.0000 | 0.0380*** | 0.0948*** | 0.0000 | | | | | | |
| IT | Retail Sales MoM | -0.0007 | 0.0092*** | 0.0000 | -0.0007 | 0.0111*** | 0.0000 | | | | | | |
| IT | Trade Balance Total | | | | | | | 0.0064*** | -0.0005 | 0.0912 | 0.0066*** | -0.0004 | 0.0296 |
| IT | Unemployment Rate Quarterly | -0.0007 | 0.0150*** | 0.0000 | -0.0006 | 0.0182*** | 0.0000 | | | | | | |
| PO | CPI MoM | | | | | | | 0.0410*** | 0.0508*** | 0.0000 | 0.0244*** | 0.0818*** | 0.0000 |
| UK | CPI MoM | 0.0001 | 0.0137*** | 0.0000 | 0.0030 | 0.0156*** | 0.0000 | -0.0004 | 0.0150*** | 0.8318 | 0.0059*** | -0.0002 | 0.1887 |
| UK | GDP QoQ-Advance | -0.0006 | 0.0055*** | 0.0122 | -0.0006 | 0.0072*** | 0.0011 | | | | | | |
| UK | Industrial Production MoM | -0.0002 | 0.0312*** | 0.0000 | 0.0010 | 0.0370*** | 0.0000 | -0.0027* | 0.0239*** | 0.0000 | 0.0074*** | -0.0010 | 0.0476 |
| UK | Retail Price Index | -0.0006 | 0.0097*** | 0.0000 | 0.0145*** | 0.0032 | 0.0967 | -0.0004 | 0.0058** | 0.0156 | 0.0032** | -0.0006 | 0.3501 |
| UK | Retail Sales Ex Auto YoY | -0.0007 | 0.0038** | 0.0855 | -0.0006 | 0.0046** | 0.0369 | | | | | | |
| EC | Gort Expend QoQ-Prel | -0.0005 | 0.0059*** | 0.0089 | -0.0004 | 0.0074*** | 0.0011 | | | | | | |
| EC | Industrial Production SA MoM | | | | | | | 0.0270*** | 0.0031 | 0.0708 | 0.0411*** | -0.0004 | 0.0000 |
| | Speech | 0.0001 | 0.0012*** | 0.0477 | 0.0003 | 0.0013*** | 0.0198 | 0.0007*** | 0.0012*** | 0.0369 | 0.0007*** | 0.0012*** | 0.0205 |

Notes: The table shows pure scheduled news effects on EUR/USD (Euro/Dollar) jump magnitude over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. US Unscheduled represents unscheduled news of US. Speech represents aggregated speech announcements. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the scheduled news: US-United States; GE-Germany; EC-Euro Zone countries; UK-United Kingdoms; IT-Italy; PO- Portugal. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 16B Pure News Effects on Jump Magnitude (*Exchange Rate: GBP/USD*)**

| Country | News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | ADP Employment Change | | | | | | | 0.0030* | -0.0002 | 0.4610 | | | |
| US | Avg. Weekly Hours Prod. | | | | | | | 0.0032* | -0.0001 | 0.5124 | 0.0040* | -0.0001 | 0.3071 |
| US | Durables Ex Transportation | -0.0004 | 0.0066*** | 0.0033 | 0.0157*** | -0.0002 | 0.0004 | | | | | | |
| US | Existing Home Sales | | | | | | | 0.0059*** | -0.0002 | 0.0033 | 0.0063*** | -0.0004 | 0.0181 |
| US | PPI MoM | -0.0005 | 0.0274*** | 0.0000 | -0.0004 | 0.0333*** | 0.0000 | 0.0373*** | 0.0304*** | 0.0007 | 0.0309*** | 0.0413*** | 0.0000 |
| US | Pending Home Sales MoM | -0.0003 | 0.0279*** | 0.0000 | -0.0003 | 0.0335*** | 0.0000 | 0.0067*** | 0.0407*** | 0.0000 | 0.0202*** | 0.0128*** | 0.1458 |
| US | Retail Sales Ex Auto MoM | -0.0004 | 0.0153*** | 0.0000 | -0.0002 | 0.0153*** | 0.0000 | -0.0009 | 0.0233*** | 0.0000 | 0.0127*** | -0.0003 | 0.0005 |
| US | Unemployment Rate | | | | | | | 0.1070*** | 0.0743*** | 0.0000 | 0.0701*** | 0.1341*** | 0.0000 |
| US | Wholesale Inventories MoM | 0.0246*** | -0.0002 | 0.0000 | 0.0175*** | -0.0002 | 0.0001 | | | | | | |
| GE | Construction Investment QoQ | | | | | | | 0.0131*** | 0.0103*** | 0.0000 | 0.0189*** | -0.0003 | 0.0000 |
| GE | Exports QoQ | | | | | | | 0.0000 | 0.0259*** | 0.0000 | 0.0101*** | -0.0002 | 0.1273 |
| GE | IFO Business Climate | -0.0002 | 0.0078*** | 0.0012 | -0.0002 | 0.0094*** | 0.0000 | | | | | | |
| GE | Industrial Production SA MoM-Prel | 0.1095*** | 0.0541*** | 0.0002 | 0.0672*** | 0.0654*** | 0.0000 | 0.0551*** | 0.0668*** | 0.0000 | 0.0572*** | 0.0615*** | 0.0000 |
| GE | ZEW Survey Current Situation | -0.0008 | 0.0203*** | 0.0000 | 0.0296*** | 0.0088*** | 0.0052 | -0.0282 | -0.1506*** | 0.0072 | | | |
| UK | CPI MoM | -0.0002 | 0.0119*** | 0.0000 | -0.0002 | 0.0141*** | 0.0000 | | | | | | |
| UK | Industrial Production MoM | -0.0004 | 0.0326*** | 0.0000 | -0.0002 | 0.0401*** | 0.0000 | 0.0108*** | -0.0110*** | 0.0000 | 0.0045*** | -0.0002 | 0.0103 |
| UK | Nationwide House Px MoM | | | | | | | 0.0297*** | 0.0634*** | 0.0000 | 0.0521*** | -0.0003 | 0.0000 |
| UK | Retail Sales Ex Auto YoY | -0.0006 | 0.0046*** | 0.0468 | -0.0005 | 0.0055*** | 0.0110 | | | | | | |
| EC | Gross Fix Cap QoQ-Final | | | | | | | -0.0003 | 0.0175*** | 0.0000 | 0.0088*** | -0.0003 | 0.0272 |
| EC | Industrial New Orders SA MoM | | | | | | | -0.0004 | 0.0067*** | 0.0000 | 0.0032** | -0.0004 | 0.3303 |
| | US Unscheduled | 0.0003*** | 0.0001 | 0.7856 | 0.0004*** | 0.0001 | 0.6975 | | | | | | |
| | Speech | -0.0006 | 0.0008** | 0.0050 | -0.0006 | 0.0011*** | 0.0020 | | | | | | |
| | CBI | | | | | | | | | | 0.0008* | -0.0002 | 0.1631 |

Notes: The table shows pure scheduled news effects on GBP/USD (Pound/Dollar) jump magnitude over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and official NBER dates. In the Euro subsample, economy states are measured by STR model and official CEPR dates. US Unscheduled represents unscheduled news of US. Speech represents aggregated speech announcements. CBI represents aggregated central bank interventions. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the scheduled news: US-United States; GE-Germany; EC-Euro Zone countries; UK- United Kingdoms. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 16C Pure News Effects on Jump Magnitude (*Exchange Rate: JPY/USD*)**

| Country | News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | Durables Ex Transportation | | | | | | | -0.0004 | 0.0073** | 0.0395 | -0.0004 | 0.0089*** | 0.0116 |
| US | Initial Jobless Claims | | | | | | | -0.0009 | 0.0184*** | 0.0000 | | | |
| US | Net Long-term TIC Flows | | | | | | | 0.0182*** | -0.0002 | 0.0903 | -0.0003 | 0.0382*** | 0.0000 |
| US | PPI MoM | 0.0451*** | -0.0003 | 0.1268 | 0.0274*** | -0.0003 | 0.0000 | | | | | | |
| GE | Construction Investment QoQ | -0.0008 | 0.0133*** | 0.1337 | 0.0132*** | -0.0005 | 0.0871 | 0.0269*** | 0.0282*** | 0.0000 | 0.0124*** | 0.0552*** | 0.0000 |
| GE | Exports QoQ | 0.0021 | 0.0918*** | 0.0000 | 0.0775*** | -0.0007 | 0.0000 | 0.0280*** | 0.0976*** | 0.0000 | 0.0644*** | -0.0006 | 0.0003 |
| GE | GDP SA QoQ-Prel | | | | | | | -0.0011 | 0.0231*** | 0.0000 | 0.0090*** | -0.0004 | 0.1455 |
| GE | IFO Business Climate | 0.0389*** | 0.0002 | 0.4040 | 0.0265*** | 0.0004 | 0.0000 | 0.0096*** | 0.0003 | 0.2971 | 0.0021 | 0.0146*** | 0.0003 |
| GE | Industrial Production SA MoM-Prel | 0.2221*** | 0.0203*** | 0.0000 | 0.1513*** | 0.0166*** | 0.0000 | 0.1051*** | 0.1096*** | 0.0000 | 0.0995*** | 0.1188*** | 0.0000 |
| GE | PPI MoM | | | | | | | 0.0043* | -0.0016 | 0.2831 | 0.0045* | -0.0051 | 0.0284 |
| IT | Business Confidence | | | | | | | 0.0076*** | 0.0220*** | 0.0000 | 0.0081*** | 0.0180*** | 0.0004 |
| IT | GDP WDA QoQ-Prel | -0.0006 | 0.0511*** | 0.0000 | | | | | | | | | |
| IT | Unemployment Rate Quarterly | -0.0008 | 0.0172*** | 0.0000 | -0.0006 | 0.0207*** | 0.0000 | | | | | | |
| JP | GDP Nominal SA QoQ-Prel | -0.0005 | 0.0048** | 0.4875 | -0.0004 | 0.0059*** | 0.0262 | | | | | | |
| SP | CPI EU Harmonised YoY-Final | 0.0139*** | -0.0048** | 0.0002 | 0.0104*** | -0.0058** | 0.0003 | | | | | | |
| SP | Retail Sales WDA YoY | | | | | | | -0.0011 | 0.0205*** | 0.0298 | -0.0005 | 0.0187*** | 0.0000 |
| UK | CPI Core YoY | -0.0009 | 0.0033* | 0.1826 | -0.0006 | 0.0041* | 0.0980 | 0.0155*** | -0.0003 | 0.0000 | 0.0084*** | 0.0139*** | 0.0195 |
| UK | CPI MoM | 0.0648*** | 0.0111*** | 0.0000 | 0.0387*** | 0.0133*** | 0.0496 | 0.0156*** | 0.0012 | 0.0562 | 0.0099*** | 0.0148*** | 0.0047 |
| UK | Industrial Production MoM | 0.1028*** | 0.0212*** | 0.0000 | 0.0582*** | 0.0265*** | 0.3944 | -0.0001 | 0.0112*** | 0.0012 | 0.0050** | 0.0020 | 0.8748 |
| | US Unscheduled | 0.0003** | 0.0007*** | 0.0000 | 0.0004*** | 0.0005** | 0.2418 | | | | | | |
| | EC Unscheduled | 0.0009*** | 0.0002 | 0.3346 | 0.0010*** | -0.0002 | 0.0450 | | | | | | |
| | CBI | | | | | | | | | | 0.0146*** | -0.0001 | 0.0000 |

Notes: The table shows pure scheduled news effects on JPY/USD (Yen/Dollar) jump magnitude over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. US Unscheduled and EC Unscheduled represent unscheduled news of US and European countries respectively. CBI represents aggregated central bank interventions. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the scheduled news: US-United States; GE-Germany; IT-Italy; JP-Japan; SP-Spain; UK-United Kingdoms. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 17 Pure News Effects on Cojump**

| Country | News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD-GBP/USD Cojump | | | | | | | | | | | | | |
| | US Unscheduled | | | | 0.1841** | -0.2147 | 0.2704 | | | | | | |
| Panel C: JPY/USD-EUR/USD Cojump | | | | | | | | | | | | | |
| | US Unscheduled | | | | 0.2984** | -0.0133 | 0.5660 | | | | | | |
| | Speech | | | | | | | 0.4653** | 0.3553 | 0.7050 | 0.4102* | 0.4680 | 0.4183 |

Notes: The table shows pure scheduled news effects on cojumps over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUR/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. US Unscheduled represents unscheduled news of US. Speech represents aggregated speech announcements. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the scheduled news: EC-Euro Zone countries; GE-Germany. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 18 Test for Asymmetric News Effects on Jump Probability**

| News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | STR | | | NBER | | | STR | | | CEPR | | |
| | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD Jump | | | | | | | | | | | | |
| Good | 0.3845 | 0.6036*** | 0.0003 | 0.4319** | 0.6162*** | 0.0000 | 0.4338*** | 0.3700** | 0.0985 | 0.5066*** | -0.0452 | 0.0079 |
| Bad | -0.0527 | 0.5372*** | 0.0435 | 0.4220** | 0.4915*** | 0.0586 | 0.2049 | 0.6520*** | 0.0004 | 0.4985*** | -0.0412 | 0.3928 |
| EC Unscheduled | | | | | | | 0.0053 | 0.2899*** | 0.0056 | | | |
| Speech | 0.2828 | 0.2313* | 0.6267 | | | | 0.2650** | 0.3874*** | 0.0948 | 0.3159*** | 0.3564** | 0.2809 |
| Panel B: GBP/USD Jump | | | | | | | | | | | | |
| Good | 0.2317 | 0.5760*** | 0.0234 | 0.2549 | 0.4399*** | 0.0011 | 0.3236** | 0.6667*** | 0.0032 | | | |
| Bad | | | | 0.2533 | 0.5738*** | 0.0381 | 0.5144*** | 0.5538*** | 0.0746 | 0.7213*** | 0.4499** | 0.6666 |
| US Unscheduled | 0.1641*** | 0.0393 | 0.5877 | 0.1863*** | 0.1384 | 0.8807 | | | | | | |
| Panel C: JPY/USD Jump | | | | | | | | | | | | |
| Good | 0.3569 | 0.3755*** | 0.2844 | 0.4762*** | 0.2212 | 0.9317 | 0.3569*** | 0.6386*** | 0.0048 | 0.5354*** | 0.2447 | 0.0002 |
| Bad | | | | | | | 0.4077*** | 0.4902*** | 0.0884 | 0.4051*** | 0.4806*** | 0.0009 |
| US Unscheduled | 0.0746 | 0.2164*** | 0.0098 | 0.1578*** | 0.2430** | 0.1259 | | | | | | |
| EC Unscheduled | | | | 0.1647* | -0.0985 | 0.3342 | 0.0676* | -0.0713 | 0.5104 | | | |
| CBI | | | | | | | | | | 0.7526*** | 0.0418 | 0.3349 |

Notes: The table shows asymmetric news effects on jump probability over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUR/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. Good and Bad represent good news and bad news respectively. US Unscheduled and EC Unscheduled represent unscheduled news of US and European countries respectively. Speech represents aggregated speech announcements. CBI represents aggregated central bank interventions. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 19 Test for Asymmetric News Effects on Jump Magnitude**

| News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | STR | | | NBER | | | STR | | | CEPR | | |
| | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD Jump | | | | | | | | | | | | |
| Good | 0.0023*** | 0.0046*** | 0.0000 | 0.0027*** | 0.0050*** | 0.0000 | 0.0016*** | 0.0024*** | 0.0000 | 0.0027*** | 0.0004 | 0.0797 |
| Bad | 0.0007 | 0.0036*** | 0.0000 | 0.0024*** | 0.0033*** | 0.0002 | 0.0017*** | 0.0024*** | 0.0008 | 0.0026*** | 0.0005 | 0.0052 |
| US Unscheduled | 0.0002** | 0.0000 | 0.6000 | 0.0002*** | 0.0000 | 0.4883 | | | | | | |
| EC Unscheduled | -0.0001 | 0.0004* | 0.0580 | 0.0003* | -0.0003 | 0.0744 | 0.0001 | 0.0005** | 0.0286 | | | |
| Speech | 0.0002 | 0.0012*** | 0.0457 | 0.0003 | 0.0014*** | 0.0170 | 0.0008*** | 0.0012*** | 0.0291 | 0.0007*** | 0.0013*** | 0.0000 |
| Panel B: GBP/USD Jump | | | | | | | | | | | | |
| Good | 0.0004 | 0.0021*** | 0.0000 | 0.0009* | 0.0022*** | 0.0000 | 0.0014*** | 0.0040*** | 0.0000 | 0.0040*** | 0.0047** | 0.0000 |
| Bad | -0.0007 | 0.0027*** | 0.0000 | 0.0008* | 0.0026*** | 0.0000 | 0.0022*** | 0.0029*** | 0.0000 | 0.0026*** | 0.0019*** | 0.0000 |
| US Unscheduled | 0.0003*** | 0.0001 | 0.8231 | 0.0004*** | 0.0001 | 0.6555 | | | | | | |
| Speech | -0.0006 | 0.0008*** | 0.0200 | -0.0005* | 0.0011*** | 0.0020 | | | | | | |
| CBI | | | | | | | | | | 0.0011** | -0.0003 | 0.1435 |
| Panel C: JPY/USD Jump | | | | | | | | | | | | |
| Good | 0.0022*** | 0.0009** | 0.0214 | 0.0027*** | 0.0005 | 0.1090 | 0.0025*** | 0.0069*** | 0.0000 | 0.0050*** | 0.0016*** | 0.1360 |
| Bad | 0.0016** | 0.0010*** | 0.1511 | 0.0021*** | 0.0007 | 0.4764 | 0.0039*** | 0.0038*** | 0.0060 | 0.0041*** | 0.0032*** | 0.0561 |
| US Unscheduled | 0.0003** | 0.0007*** | 0.0006 | 0.0005*** | 0.0005** | 0.2227 | | | | | | |
| EC Unscheduled | 0.0010*** | 0.0002 | 0.3420 | 0.0010*** | -0.0002 | 0.0498 | | | | | | |
| CBI | | | | | | | | | | 0.0146*** | -0.0001 | 0.0000 |

Notes: The table shows asymmetric news effects on jump magnitude over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUR/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. Good and Bad represent good news and bad news respectively. US Unscheduled and EC Unscheduled represent unscheduled news of US and European countries respectively. Speech represents aggregated speech announcements. CBI represents aggregated central bank interventions. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 20 Test for Asymmetric Effects on Cojump**

| News | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | STR | | | NBER | | | STR | | | CEPR | | |
| | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD-GBP/USD Cojump | | | | | | | | | | | | |
| Good | | | | | | | 0.4856*** | 0.7816*** | 0.0254 | | | |
| Bad | | | | 0.4120 | 0.7519*** | 0.0086 | | | | | | |
| US Unscheduled | | | | 0.1813** | -0.2684 | 0.2372 | | | | | | |
| Panel B: GBP/USD-JPY/USD Cojump | | | | | | | | | | | | |
| Good | | | | | | | 0.4425* | 0.5571* | 0.3020 | | | |
| Bad | | | | | | | 0.4356* | 0.8672*** | 0.0203 | | | |
| Panel C: JPY/USD-EUR/USD Cojump | | | | | | | | | | | | |
| Good | 0.8427** | 0.6083*** | 0.4599 | 0.6937** | 0.6450*** | 0.2375 | | | | | | |
| Bad | | | | | | | 0.3583 | 0.6831*** | 0.0576 | | | |
| US Unscheduled | | | | 0.2955** | -0.0129 | 0.5710 | | | | | | |
| Speech | | | | | | | 0.4317** | 0.2644 | 0.8830 | 0.4102* | 0.4680 | 0.4183 |

Notes: The table shows asymmetric news effects on cojumps over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUR/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. Good and Bad represent good news and bad news respectively. US Unscheduled represents unscheduled news of US. Speech represents aggregated speech announcements. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 21A Speech Effects on Jump Probability (Exchange Rate: EUR/USD)**

| Country | Speech | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | Fed | | | | | | | 0.2303 | 0.3983* | 0.2645 | 0.4489*** | -0.1688 | 0.2786 |
| US | Ben Shalom Bernanke (Fed) | | | | | | | 0.5107*** | -0.3496 | 0.3250 | 0.5716*** | -0.0698 | 0.3955 |
| US | Donald Lewis Kohn (Fed) | 0.5053* | 0.2589 | 0.9777 | 0.3612 | 0.3062* | 0.5685 | | | | | | |
| US | Charles Irving Plosser (Fed) | | | | | | | 0.5827*** | 0.4357 | 0.6799 | 0.6403*** | 0.2965 | 0.9529 |
| US | Daniel Tarullo (FED) | | | | | | | | | | 3.0803* | -2.2584 | 0.6022 |
| EUR | ECB | | | | | | | -0.0435 | 0.2607* | 0.0796 | 0.1966* | -0.2656 | 0.1411 |
| EUR | Mario Draghi (ECB) | | | | | | | 0.0892 | 1.0475*** | 0.0197 | | | |
| EUR | John Hurley (ECB) | -3.8429 | 0.5508* | 0.9237 | -3.9176 | 0.7963** | 0.8463 | | | | | | |
| EUR | Erkki Liikanen (ECB) | | | | | | | 0.7342*** | 0.3021 | 0.8966 | | | |
| EUR | Peter Praet (ECB) | | | | | | | -0.2170 | 2.1342*** | 0.0135 | | | |
| EUR | Juergen Stark (ECB) | 0.5802*** | 0.1666 | 0.6606 | | | | | | | | | |
| EUR | Jean-Claude Trichet (ECB) | | | | 0.0627 | 0.1937** | 0.1837 | | | | | | |
| UK | BOE | | | | | | | 0.3602 | 1.1646*** | 0.0287 | | | |
| UK | Andy Haldane (BOE) | | | | | | | 2.1672*** | 2.9836*** | 0.0030 | 2.4221*** | -0.6691 | 0.5936 |
| | EC Unscheduled | | | | | | | 0.0034 | 0.2972*** | 0.0047 | | | |
| | Scheduled News | 0.3981** | 0.7917*** | 0.0000 | 0.6279*** | 0.7839*** | 0.0000 | 0.5288*** | 0.7835*** | 0.0000 | 0.7050*** | 0.3940*** | 0.7661 |

Notes: The table shows speech effects on EUR/USD (Euro/Dollar) jump probability over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. Speech reports the speakers and the source of the speeches. Scheduled News represents aggregated scheduled news announcements. EC Unscheduled represents unscheduled news of European countries. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the speech: US-United States; UK-United Kingdoms; EUR-Euro Zone countries. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 21B Speech Effects on Jump Probability (Exchange Rate: GBP/USD)**

| Country | Speech | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | Fed | | | | | | | 0.9490** | -0.1177 | 0.3804 | 0.8709** | -0.4269 | 0.3288 |
| US | Ben Shalom Bernanke (Fed) | | | | 0.1900 | 0.5658* | 0.2143 | | | | | | |
| US | Timothy Geithner (Fed) | 2.7543*** | -3.2574 | 0.4965 | 2.5323*** | -3.3026 | 0.4942 | | | | | | |
| US | Alan Greenspan (Fed) | 1.9833*** | -0.2182 | 0.1933 | 1.3228** | -0.1539 | 0.3734 | | | | | | |
| US | Thomas Michael Hoenig (FED) | 1.5557* | 0.1980 | 0.6149 | 1.4152* | 0.2349 | 0.6829 | | | | | | |
| US | Donald Lewis Kohn (Fed) | 0.6967** | 0.4049* | 0.8368 | 0.5101 | 0.4628** | 0.4496 | | | | | | |
| US | Sandra Pianalto (Fed) | 2.0202*** | 0.3945 | 0.4623 | 2.0864*** | -15.8054 | 0.7665 | | | | | | |
| US | Charles Irving Plosser (Fed) | | | | | | | | | | 0.7220*** | 0.4732 | 0.8010 |
| EUR | ECB | -0.5932 | 0.2496** | 0.0349 | -0.2082 | 0.2830** | 0.0371 | | | | | | |
| EUR | Klaus Liebscher (ECB) | | | | 0.8170** | 0.2495 | 0.7110 | | | | | | |
| EUR | Lucas Papademos (ECB) | -0.6442** | 0.1016 | 0.4596 | | | | | | | | | |
| EUR | Jean-Claude Trichet (ECB) | 0.1100 | 0.2651** | 0.2056 | 0.1936 | 0.2116* | 0.4453 | | | | | | |
| UK | BOE | 3.2784** | -15.7610 | 0.8425 | 3.1813** | -16.0085 | 0.8476 | 0.8611 | 2.5527*** | 0.0009 | 1.7646*** | 1.2367 | 0.7826 |
| UK | Andy Haldane (BOE) | | | | | | | 0.4544 | 4.3633*** | 0.0044 | 2.9465*** | -0.7328 | 0.6935 |
| UK | Mark Joseph Carney (BOE) | | | | | | | -1.9558 | 1.3782*** | 0.6254 | | | |
| | US Unscheduled | 0.1848*** | 0.0397 | 0.5068 | 0.2024*** | 0.1430 | 0.7207 | | | | | | |
| | EC Unscheduled | 0.3169* | 0.0441 | 0.5063 | | | | 0.1068* | 0.1862 | 0.0724 | | | |
| | Scheduled News | 0.3641* | 0.7496*** | 0.0000 | 0.4227*** | 0.7788*** | 0.0000 | 0.6438*** | 0.8760*** | 0.0000 | 0.7908*** | 0.5742*** | 0.1787 |

Notes: The table shows speech effects on GBP/USD (Pond/Dollar) jump probability over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. Speech reports the speakers and the source of the speeches. Scheduled News represents aggregated scheduled news announcements. US Unscheduled and EC Unscheduled represent unscheduled news of US and European countries respectively. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the speech: US-United States; UK-United Kingdoms; EUR-Euro Zone countries. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 21C Speech Effects on Jump Probability (Exchange Rate: JPY/USD)**

| Country | Speech | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | Ben Shalom Bernanke (Fed) | | | | 0.1386 | 0.3702* | 0.2548 | 0.3730** | 0.5595* | 0.2277 | | | |
| US | Donald Lewis Kohn (Fed) | 0.4685** | 0.0147 | 0.3941 | 0.3606* | 0.0419 | 0.5934 | | | | | | |
| US | Janet Louise Yellen (Fed) | | | | 2.8416* | 0.5140 | 0.6393 | | | | | | |
| EUR | ECB | | | | | | | 0.0570 | 0.4257* | 0.1410 | | | |
| EUR | John Hurley (ECB) | -0.4922 | 0.6423* | 0.6402 | 0.8910** | -0.5114 | 0.6285 | | | | | | |
| EUR | Ewald Nowotny (ECB) | | | | | | | | | | 0.8392* | 0.4471 | 0.9799 |
| EUR | Athanasios Orphanides (ECB) | | | | | | | 0.2664 | 1.4398** | 0.0978 | -6.8970 | 1.0741** | 0.8840 |
| EUR | Lucas Papademos (ECB) | 0.5551* | 0.2851 | 0.9775 | | | | | | | | | |
| EUR | Guy Quaden (ECB) | 0.7709* | -7.9794 | 0.9998 | | | | | | | | | |
| EUR | Jean-Claude Trichet (ECB) | | | | 0.0338 | 0.2937** | 0.1281 | -0.0534 | 0.4059* | 0.0841 | | | |
| UK | BOE | | | | | | | -0.3710 | 1.9493* | 0.0783 | | | |
| UK | Charlie Bean (BOE) | | | | | | | 0.8765*** | -0.3529 | 0.7173 | 0.9665*** | -0.3290 | 0.5987 |
| | US Unscheduled | 0.0772 | 0.2158*** | 0.0110 | 0.1584*** | 0.2495** | 0.1125 | | | | | | |
| | EC Unscheduled | | | | 0.1665* | -0.0988 | 0.3314 | 0.0660* | -0.0892 | 0.4463 | | | |
| | Scheduled News | 0.4539*** | 0.3805*** | 0.2253 | 0.5728*** | 0.2812** | 0.9680 | 0.5488*** | 0.7456*** | 0.0000 | 0.5966*** | 0.6381*** | 0.0013 |

Notes: The table shows speech effects on JPY/USD (Yen/Dollar) jump probability over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. Speech reports the speakers and the source of the speeches. Scheduled News represents aggregated scheduled news announcements. US Unscheduled and EC Unscheduled represent unscheduled news of US and European countries respectively. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the speech: US-United States; UK-United Kingdoms; EUR-Euro Zone countries. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 22A Speech Effects on Jump Magnitude (*Exchange Rate: EUR/USD*)**

| Country | Speech | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | Fed | 0.0014* | 0.0003 | 0.4897 | | | | | | | 0.0007** | -0.0003 | 0.1680 |
| US | Ben Shalom Bernanke (Fed) | | | | -0.0008 | 0.0010* | 0.0174 | 0.0018*** | -0.0004 | 0.0899 | 0.0028*** | 0.0000 | 0.0125 |
| US | James B. Bullard (Fed) | 0.0031** | -0.0011 | 0.3574 | | | | | | | | | |
| US | Charles Evans (Fed) | 0.0026*** | -0.0004 | 0.1969 | -0.0005 | 0.0138*** | 0.0000 | | | | | | |
| US | Roger W. Ferguson (Fed) | -0.0010 | 0.0038** | 0.2736 | -0.0016 | 0.0037** | 0.2520 | | | | | | |
| US | Timothy Geithner (Fed) | 0.0517*** | -0.0006 | 0.0000 | 0.0387*** | -0.0007 | 0.0000 | | | | | | |
| US | Alan Greenspan (Fed) | | | | | | | 0.0049** | -0.0003 | 0.5495 | 0.0050** | -0.0011 | 0.4362 |
| US | Donald Lewis Kohn (Fed) | 0.0035*** | 0.0006 | 0.0789 | 0.0016** | 0.0009* | 0.8479 | -0.0005 | 0.0023** | 0.0233 | -0.0007 | 0.0013* | 0.2749 |
| US | Dennis P. Lockhart (Fed) | -0.0014 | 0.0095*** | 0.0000 | 0.0031** | -0.0010 | 0.4287 | | | | -0.0007 | 0.0023** | 0.0153 |
| US | Charles Irving Plosse (Fed) | | | | -0.0010 | 0.0029** | 0.0230 | 0.0017*** | 0.0014* | 0.4980 | 0.0025*** | 0.0002 | 0.2086 |
| US | Gary H. Stern (Fed) | 0.0025*** | -0.0003 | 0.0108 | 0.0022*** | -0.0003 | 0.0358 | | | | | | |
| UK | BOE | | | | | | | 0.0004 | 0.0039*** | 0.0007 | 0.0025*** | -0.0015 | 0.0776 |
| UK | Andy Haldane (BOE) | | | | | | | 0.0075*** | 0.0161*** | 0.0000 | 0.0114*** | -0.0006 | 0.1724 |
| EUR | Mario Draghi (ECB) | | | | | | | -0.0001 | 0.0025** | 0.0274 | | | |
| EUR | Klaus Liebscher (ECB) | -0.0005 | 0.0032*** | 0.2362 | -0.0003 | 0.0044*** | 0.0017 | | | | | | |
| EUR | Erkki Liikanen (ECB) | | | | | | | 0.0017*** | -0.0001 | 0.3618 | 0.0015*** | -0.0005 | 0.2833 |
| EUR | Lucas Papademos (ECB) | 0.0134** | -0.0005 | 0.0000 | 0.0067*** | -0.0005 | 0.0000 | | | | | | |
| EUR | Jean-Claude Trichet (ECB) | -0.0003 | 0.0005*** | 0.0089 | -0.0001 | 0.0004** | 0.0631 | | | | | | |
| EUR | Nout Wellink (ECB) | | | | | | | 0.0033*** | -0.0003 | 0.3871 | | | |

Notes: The table shows speech effects on EUR/USD (Euro/Dollar) jump magnitude over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. Speech reports the speakers and the source of the speeches. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the speech: US-United States; UK-United Kingdoms; EUR-Euro Zone countries. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 22B Speech Effects on Jump Magnitude (*Exchange Rate: GBP/USD*)**

| Country | Speech | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | Fed | 0.0060*** | 0.0005 | 0.0082 | 0.0042*** | 0.0007 | 0.1170 | 0.0018*** | -0.0003 | 0.1348 | 0.0018*** | -0.0005 | 0.0732 |
| US | Ben Shalom Bernanke (Fed) | -0.0011 | 0.0011* | 0.0376 | | | | 0.0013** | -0.0006 | 0.1781 | 0.0021*** | -0.0004 | 0.0368 |
| US | Charles Evans (Fed) | | | | | | | 0.0010* | -0.0005 | 0.1680 | 0.0010* | -0.0005 | 0.1672 |
| US | Timothy Geithner (Fed) | 0.0922*** | -0.0008 | 0.0000 | 0.0691*** | -0.0009 | 0.0000 | | | | | | |
| US | Richard W. Fisher (Fed) | | | | | | | -0.0004 | 0.0035** | 0.1237 | | | |
| US | Alan Greenspan (Fed) | 0.0199*** | 0.0001 | 0.0000 | 0.0061*** | 0.0002 | 0.0564 | | | | | | |
| US | Thomas Michael Hoenig (Fed) | 0.0054** | -0.0001 | 0.2167 | 0.0042* | 0.0000 | 0.3507 | | | | | | |
| US | Donald Lewis Kohn (Fed) | 0.0055*** | 0.0006 | 0.0034 | 0.0027*** | 0.0008 | 0.4004 | | | | | | |
| US | Sandra Pianalto (Fed) | 0.0612*** | 0.0000 | 0.0000 | 0.0464*** | -0.0010 | 0.0000 | | | | | | |
| US | Charles Irving Plosser (Fed) | | | | | | | 0.0023*** | -0.0006 | 0.0175 | 0.0018*** | 0.0003 | 0.4086 |
| US | Eric S. Rosengren (Fed) | | | | | | | 0.0015*** | -0.0003 | 0.1491 | 0.0015*** | -0.0003 | 0.1624 |
| UK | BOE | 0.0225*** | -0.0011 | 0.0157 | 0.0189*** | -0.0013 | 0.0561 | 0.0010 | 0.0067*** | 0.0000 | 0.0038*** | 0.0007 | 0.5547 |
| UK | Charlie Bean (BOE) | | | | | | | -0.0007 | 0.0120*** | 0.0000 | -0.0007 | 0.0059*** | 0.0040 |
| UK | Andy Haldane (BOE) | | | | | | | 0.0004 | 0.0172*** | 0.0000 | 0.0070*** | -0.0019 | 0.3457 |
| UK | Mark Joseph Carney (BOE) | | | | | | | -0.0004 | 0.0093*** | 0.0000 | | | |
| EUR | ECB | -0.0007 | 0.0005** | 0.0020 | -0.0004 | 0.0006** | 0.0061 | | | | | | |
| EUR | Mario Draghi (ECB) | 0.0284*** | -0.0011 | 0.0000 | 0.0104*** | -0.0010 | 0.1055 | | | | | | |
| EUR | Lucas Papademos (ECB) | 0.0048*** | 0.0003 | 0.0004 | 0.0035*** | -0.0002 | 0.0007 | | | | | | |
| EUR | Jean-Claude Trichet (ECB) | 0.0000 | 0.0004** | 0.1260 | | | | | | | | | |

Notes: The table shows speech effects on GBP/USD (Pound/Dollar) jump magnitude over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. Speech reports the speakers and the source of the speeches. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the speech: US-United States; UK-United Kingdoms; EUR-Euro Zone countries. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 22C Speech Effects on Jump Magnitude (*Exchange Rate: JPY/USD*)**

| Country | Speech | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| US | Ben Shalom Bernanke (Fed) | | | | | | | 0.0010* | 0.0008 | 0.8033 | 0.0027*** | -0.0006 | 0.0213 |
| US | Charles Evans (Fed) | | | | -0.0008 | 0.0068*** | 0.0021 | | | | 0.0011* | -0.0002 | 0.3257 |
| US | Timothy Geithner (Fed) | 0.0452*** | -0.0007 | 0.0000 | 0.0340*** | -0.0007 | 0.0000 | | | | | | |
| US | Donald Lewis Kohn (Fed) | 0.0020** | -0.0001 | 0.0929 | 0.0011* | 0.0000 | 0.3123 | -0.0005 | 0.0037*** | 0.0020 | -0.0004 | 0.0022** | 0.1433 |
| US | Jeffrey M. Lacker (Fef) | | | | | | | | | | -0.0031 | 0.0071* | 0.0393 |
| US | Henry Paulson (Treasury) | 0.0036*** | -0.0003 | 0.0002 | 0.0014*** | -0.0003 | 0.1321 | | | | | | |
| US | Charles Irving Plosser (Fed) | | | | | | | 0.0037*** | -0.0006 | 0.0203 | 0.0039*** | -0.0007 | 0.0091 |
| UK | Charlie Bean (BOE) | | | | | | | 0.0084*** | -0.0005 | 0.1549 | 0.0108*** | -0.0007 | 0.0128 |
| UK | Paul Tucker (BOE) | | | | | | | 0.0030** | 0.0000 | 0.7931 | 0.0001 | 0.0070*** | 0.0042 |
| EUR | Joaquin Almunia (ECO) | | | | | | | -0.0004 | 0.0054** | 0.0665 | -0.0003 | 0.0074*** | 0.0052 |
| EUR | Mario Draghi (ECB) | -0.0008 | 0.0365* | 0.2281 | -0.0119 | 0.0698** | 0.0155 | | | | | | |
| EUR | John Hurley (ECB) | -0.0008 | 0.0060*** | 0.0072 | 0.0108*** | -0.0004 | 0.0061 | | | | | | |
| EUR | Athanasios Orphanides (ECB) | | | | | | | 0.0000 | 0.0080* | 0.0688 | | | |
| EUR | Lucas Papademos (ECB) | 0.0018 | 0.0017*** | 0.3340 | 0.0046*** | -0.0003 | 0.0019 | | | | | | |
| EUR | Guy Quaden (ECB) | 0.0070*** | -0.0004 | 0.0155 | 0.0057*** | -0.0003 | 0.0523 | | | | | | |
| EUR | Jean-Claude Trichet (ECB) | -0.0007 | 0.0014** | 0.0096 | -0.0003 | 0.0016*** | 0.0133 | -0.0003 | 0.0014* | 0.0542 | | | |

Notes: The table shows speech effects on JPY/USD (Yen/Dollar) jump magnitude over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. Speech reports the speakers and the source of the speeches. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the speech: US-United States; UK-United Kingdoms; EUR-Euro Zone Countries. *, **, *** denote statistical significance at 10%, 5% and 1% level.

**Table 23 Speech Effects on Cojump**

| Country | Speech | US Subsample | | | | | | EU Subsample | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | STR | | | NBER | | | STR | | | CEPR | | |
| | | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff | Recession | Expansion | P-diff |
| Panel A: EUR/USD-GBP/USD Cojump | | | | | | | | | | | | | |
| US | Fed | 0.6502 | 0.4801* | 0.6925 | | | | 0.8017*** | 0.0033 | 0.5134 | 0.6118** | 0.5915 | 0.5948 |
| US | Donald Lewis Kohn (Fed) | 0.7772*** | 0.5334*** | 0.0639 | 0.6708*** | 0.5677*** | 0.2858 | | | | | | |
| US | Sandra Pianalto (Fed) | 2.4105*** | -11.2046 | 0.9981 | | | | | | | | | |
| US | Charles Irving Plosser (Fed) | | | | | | | | | | 0.9038*** | 1.0015*** | 0.1735 |
| UK | BOE | | | | | | | -0.3931 | 1.9086*** | 0.0113 | | | |
| UK | Andy Haldane (BOE) | | | | | | | 1.7557* | 3.7169*** | 0.0013 | 2.7032*** | -1.1167 | 0.6624 |
| EUR | ECB | -0.1188 | 0.4008** | 0.1042 | -0.2195 | 0.4879*** | 0.0322 | | | | | | |
| EUR | John Hurley (ECB) | -3.4966 | 0.8858*** | 0.9491 | -3.5958 | 1.0314*** | 0.9126 | | | | | | |
| EUR | Jean-Claude Trichet | | | | 0.2140 | 0.2978*** | 0.2061 | | | | | | |
| Panel B: GBP/USD-JPY/USD Cojump | | | | | | | | | | | | | |
| US | Fed | | | | | | | 0.9859*** | 0.0841 | 0.6408 | 0.9376** | 0.2112 | 0.7675 |
| UK | Andy Haldane (BOE) | | | | | | | -0.5409 | 3.9696*** | 0.0236 | 2.8076*** | -0.6538 | 0.8322 |
| EUR | Yves Mersch (ECB) | -4.0590 | 5.2729** | 0.7783 | -4.0060 | 5.3311** | 0.7305 | | | | | | |
| Panel C: JPY/USD-EUR/USD Cojump | | | | | | | | | | | | | |
| US | Fed | | | | | | | 0.9030*** | 0.8257* | 0.4177 | 1.1003*** | 0.0657 | 0.5207 |
| US | Ben Shalom Bernanke (Fed) | | | | | | | 0.8950*** | 0.1862 | 0.6759 | | | |
| US | Roger W. Ferguson (Fed) | -3.0514 | 1.6187*** | 0.9655 | -3.1707 | 1.5543*** | 0.9562 | | | | | | |
| UK | Andy Haldane (BOE) | | | | | | | -0.5571 | 3.9651*** | 0.0109 | 3.0057*** | -0.7137 | 0.7735 |
| EUR | Yves Mersch (ECB) | -4.2100 | 4.8079** | 0.8071 | -4.2318 | 4.8754** | 0.7257 | | | | | | |
| Panel D: EUR/USD-GBP/USD-JPY/USD Cojump | | | | | | | | | | | | | |
| UK | Andy Haldane (BOE) | | | | | | | -0.5326 | 4.1239*** | 0.0384 | 2.9756*** | -0.7263 | 0.8477 |
| EUR | Yves Mersch (ECB) | -4.0460 | 5.4986** | 0.8817 | -4.1545 | 5.5768** | 0.8266 | | | | | | |

Notes: The table shows speech effects on the cojumps over recession and expansion in the US subsample and the Euro subsample. For comparison, in the US subsample, economy states are measured by STR model and NBER indicators. In the Euro subsample, economy states are measured by STR model and CEPR indicators. EUS/USD, GBP/USD and JPY/USD denote Euro/Dollar, Pound/Dollar and Yen/Dollar respectively. Speech reports the speakers and the source of the speeches. Scheduled News represents aggregated scheduled news announcements. US Unscheduled represents unscheduled news of US. P-diff represents the p-value of the difference between the coefficients in recession and expansion, to show whether the coefficients are statistically different when they are both significant over recession and expansion. Country presents the corresponding country name of the speech: US-United States. *, **, *** denote statistical significance at 10%, 5% and 1% level.

# Figures

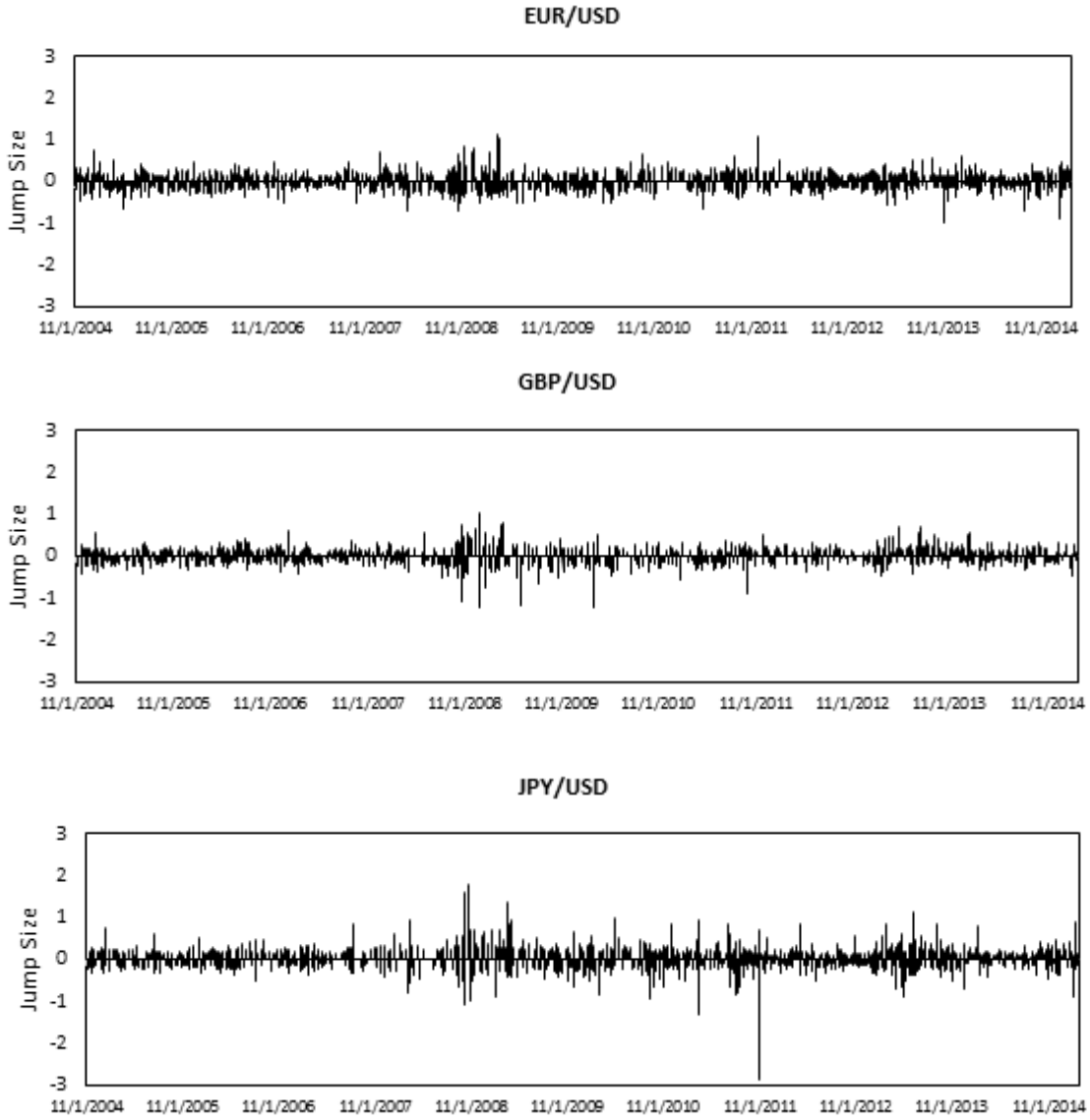


**Figure 1: Time Series of Significant Jumps.** The figure illustrates significant jumps on the basis of $FJ_{t,i}$ given in equation (4). The X-axis displays date and the Y-axis displays the size of variable $Jump_{t,i}$ given in equation (5).

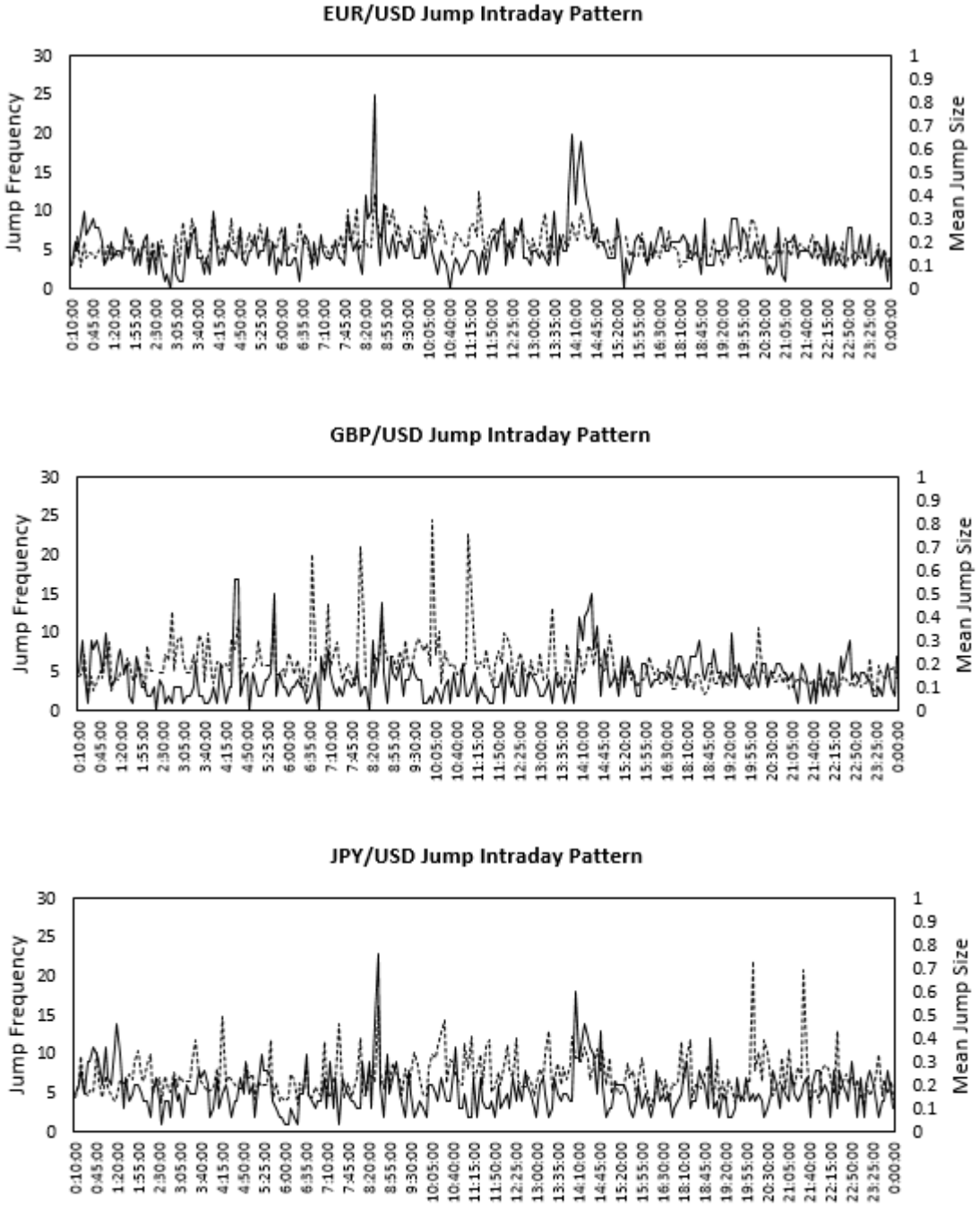


**Figure 2 Jump Intraday Pattern.** The X-axis represents the intraday time. The left Y-axis shows jump frequency, while the right Y-axis shows the mean of absolute jump sizes. The solid lines display the number of jumps and the dashed lines displays the mean jump sizes.

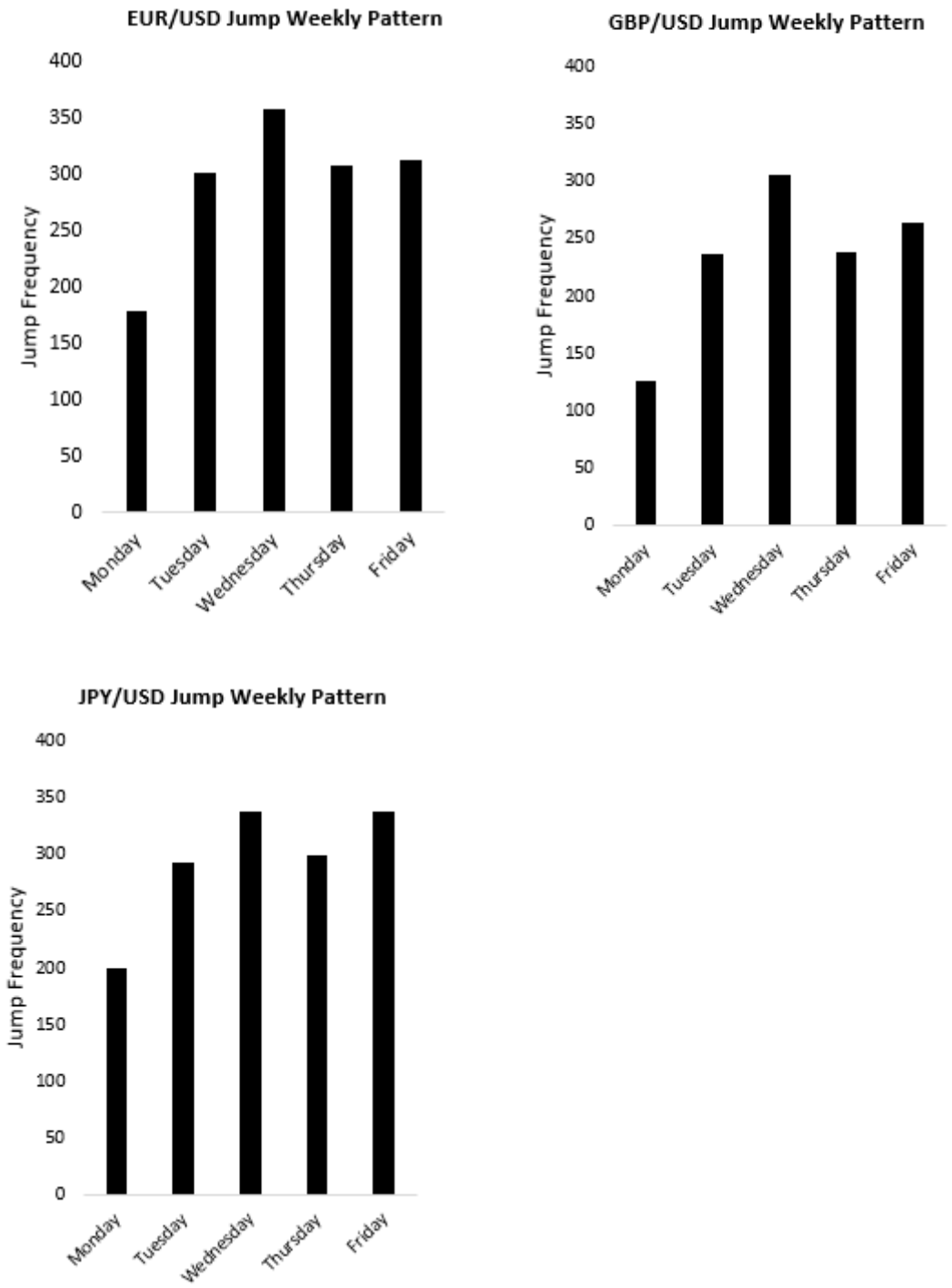


**Figure 3 Jump Weekly Pattern**. The X-axis displays the weekday of the week from Monday to Friday. The Y-axis displays the jump frequency.

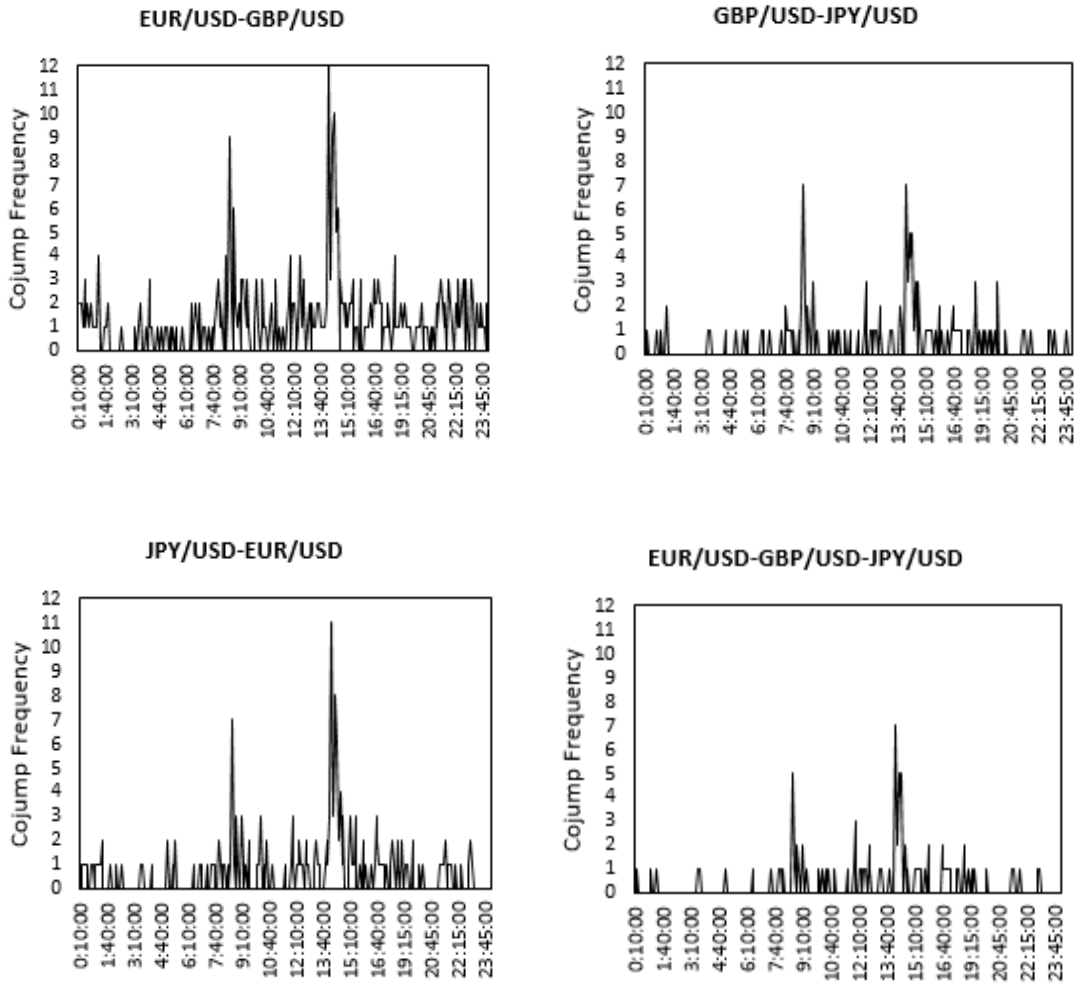


**Figure 4 Cojump Intraday Pattern.** The X-axis displays the intraday time. The Y-axis displays the frequency of cojumps.

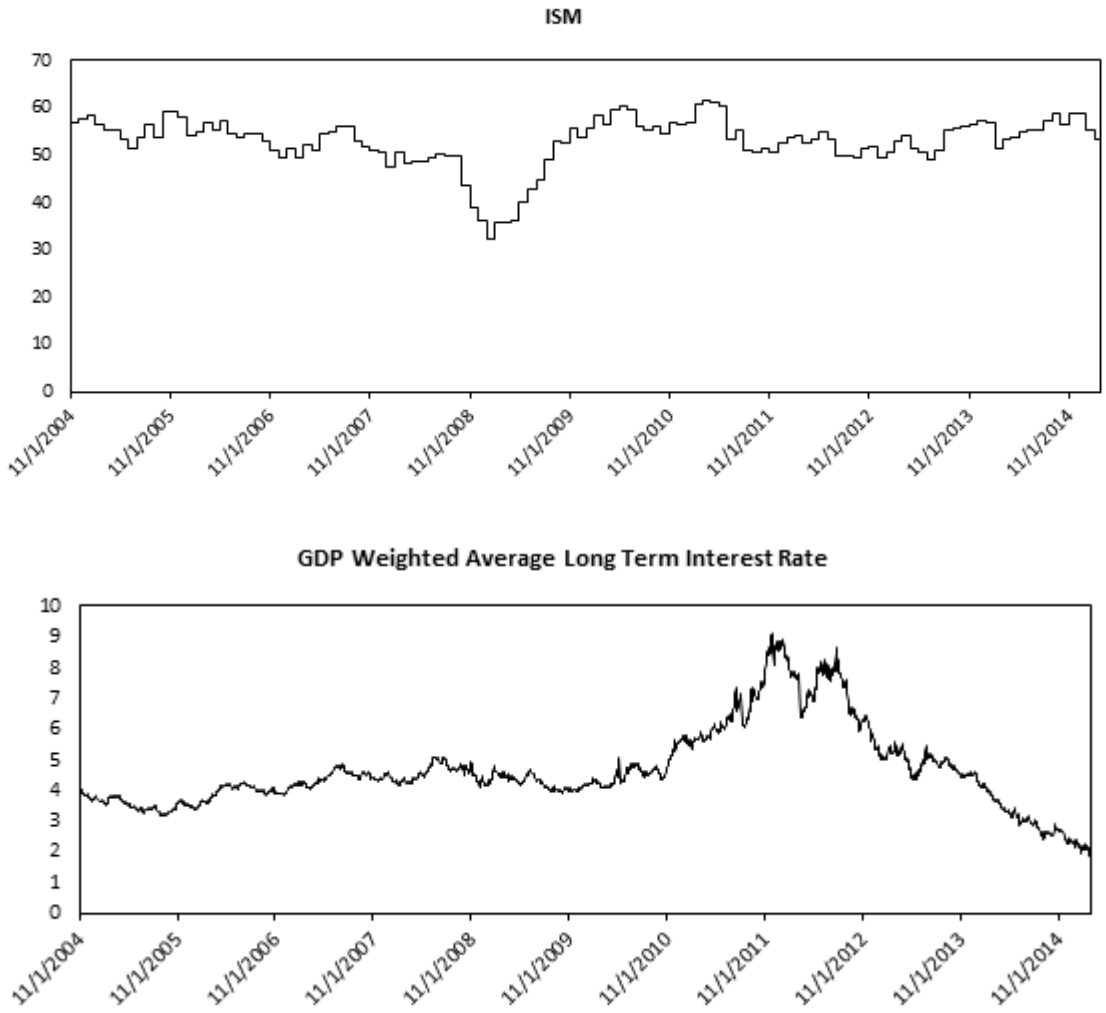


**Figure 5 Transition Variables.** The figure plots the pattern of transition variables: ISM and GDP weighted Average Long Term Interest Rate. ISM (Institute of Supply Management) is manufacturing index surveyed from over 300 manufacturing firms to identify US business cycles. GDP weighted average long term interest rate of four Euro countries: Italy, Spain, Portugal and Greece is to identify Euro Zone crisis.

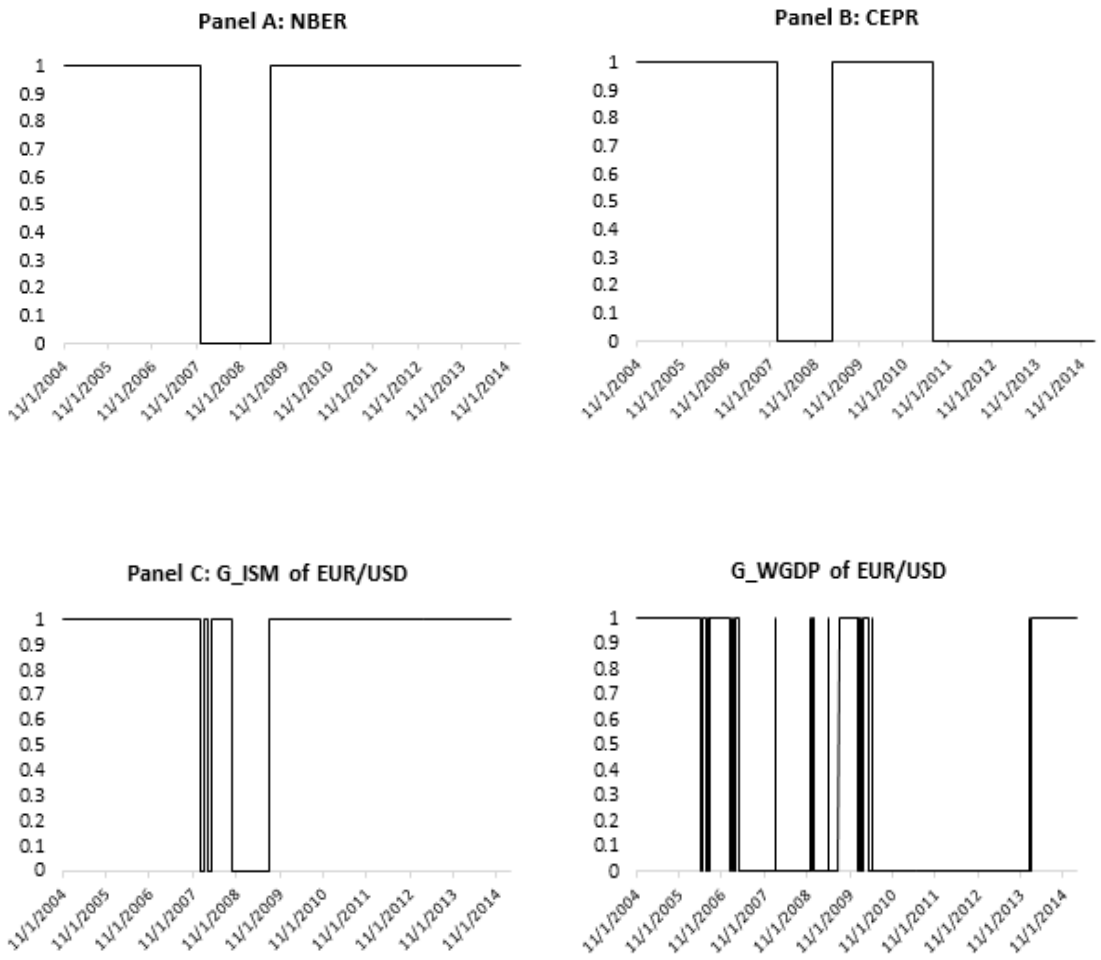


**Figure 6 Transition Function.** The figure describes the business cycles for US and European economy by using STR model and the NBER (The National Bureau of Economic Research) and CEPR (Centre for Economic Policy Research) indicators respectively. Panel A & B plot the business states according to the dates announced by NBER and CEPR. Value of one and zero denote expansion and recession respectively. Panel C & D plot the business states based on the fitted value of logistic transition function for US and Europe with corresponding transition variables: ISM (Institute of Supply Management) and GDP weighted average long term interest rate of Italy, Spain, Portugal and Greece.

# Appendix A: Description of the Macroeconomic News

In the following table, usual effect is the criteria to judge good or bad news. Advance/Preliminary/Final represents the Advance, Preliminary and Final report for the news announced for several times. SA/NSA means Seasonal Adjusted or Non Seasonal Adjusted figures. YoY, MoM, QoQ represents the comparison between the current released figure and the previous figure Year over Year, Month over Month, Quarter over Quarter. WDA denotes for Weighted Density Approximation.

| Country | Macroeconomic News | Usual Effect |
|---|---|---|
| US | ADP Employment Change | Actual > Forecast = Good for currency; |
| US | Avg Hourly Earning MOM Prod | Actual > Forecast = Good for currency; |
| US | Avg Weekly Hours Production | Actual > Forecast = Good for currency; |
| US | Business Inventories | Actual < Forecast = Good for currency; |
| US | Change in Nonfarm Payrolls | Actual > Forecast = Good for currency; |
| US | Chicago Purchasing Manager | Actual > Forecast = Good for currency; |
| US | Construction Spending MoM | Actual > Forecast = Good for currency; |
| US | Consumer Confidence Index | Actual > Forecast = Good for currency; |
| US | Core PCE QoQ - Advance | Actual > Forecast = Good for currency; |
| US | Core PCE QoQ - Preliminary | Actual > Forecast = Good for currency; |
| US | CPI Ex Food and Energy MoM | Actual > Forecast = Good for currency; |
| US | Durables Ex Transportation | Actual > Forecast = Good for currency; |
| US | FOMC Rate Decision | Actual > Forecast = Good for currency; |
| US | Empire Manufacturing | Actual > Forecast = Good for currency; |
| US | Factory Orders | Actual > Forecast = Good for currency; |
| US | Existing Home Sales | Actual > Forecast = Good for currency; |
| US | GDP Annualized QoQ - Advance | Actual > Forecast = Good for currency; |
| US | GDP Annualized QoQ -Preliminary | Actual > Forecast = Good for currency; |
| US | Housing Starts | Actual > Forecast = Good for currency; |
| US | IBD/TIPP Economic Optimism | Actual > Forecast = Good for currency; |
| US | Import Price Index MoM | Actual > Forecast = Good for currency; |
| US | Industrial Production MoM | Actual > Forecast = Good for currency; |
| US | Initial Jobless Claims | Actual < Forecast = Good for currency; |
| US | ISM Manufacturing | Actual > Forecast = Good for currency; |
| US | ISM Milwaukee | Actual > Forecast = Good for currency; |
| US | ISM Non-Manf. Composite | Actual > Forecast = Good for currency; |
| US | Net Long-term TIC Flows | Actual > Forecast = Good for currency; |
| US | Minutes of FOMC Meeting | More hawkish than expected = Good for currency; |
| US | NAHB Housing Market Index | Actual > Forecast = Good for currency; |
| US | New Home Sales | Actual > Forecast = Good for currency; |
| US | Nonfarm Productivity - Final | Actual > Forecast = Good for currency; |
| US | Nonfarm Productivity -Preliminary | Actual > Forecast = Good for currency; |

| | | |
|---|---|---|
| US | PCE Core MoM | Actual > Forecast = Good for currency; |
| US | Pending Home Sales MoM | Actual > Forecast = Good for currency; |
| US | Personal Consumption -Preliminary | Actual > Forecast = Good for currency; |
| US | Personal Spending | Actual > Forecast = Good for currency; |
| US | Philadelphia Fed Business Outlook | Actual > Forecast = Good for currency; |
| US | PPI Ex Food and Energy MoM | Actual > Forecast = Good for currency; |
| US | PPI MoM | Actual > Forecast = Good for currency; |
| US | Retail Sales Ex Auto MoM | Actual > Forecast = Good for currency; |
| US | Trade Balance | Actual > Forecast = Good for currency; |
| US | Unemployment Rate | Actual < Forecast = Good for currency; |
| US | Univ. of Michigan Confidence -Preliminary | Actual > Forecast = Good for currency; |
| US | Wholesale Inventories MoM | Actual < Forecast = Good for currency; |
| UK | Bank of England Bank Rate | Actual > Forecast = Good for currency; |
| UK | CPI Core YoY | Actual > Forecast = Good for currency; |
| UK | CPI MoM | Actual > Forecast = Good for currency; |
| UK | GDP QoQ - Advance | Actual > Forecast = Good for currency; |
| UK | Industrial Production MoM | Actual > Forecast = Good for currency; |
| UK | Nationwide House PX MoM | Actual > Forecast = Good for currency; |
| UK | Retail Price Index | Actual > Forecast = Good for currency; |
| UK | Retail Sales Ex Auto YoY | Actual > Forecast = Good for currency; |
| UK | RPI Ex Mort Int.Payments (YoY) | Actual > Forecast = Good for currency; |
| UK | RPI MoM | Actual > Forecast = Good for currency; |
| UK | Total Business Investment QoQ-Preliminary | Actual > Forecast = Good for currency; |
| UK | Visible Trade Balance GBP/Mn | Actual > Forecast = Good for currency; |
| SP | CPI EU Harmonised YoY - Final | Actual > Forecast = Good for currency; |
| SP | CPI MoM | Actual > Forecast = Good for currency; |
| SP | Retail Sales WDA YoY | Actual > Forecast = Good for currency; |
| SP | Unemployment Rate | Actual < Forecast = Good for currency; |
| PO | CPI MoM | Actual > Forecast = Good for currency; |
| PO | GDP YoY - Final | Actual > Forecast = Good for currency; |
| JP | GDP Nominal SA QoQ -Preliminary | Actual > Forecast = Good for currency; |
| JP | Housing Starts YoY | Actual > Forecast = Good for currency; |
| JP | Retail Trade YoY | Actual > Forecast = Good for currency; |
| IT | Business Confidence | Actual > Forecast = Good for currency; |
| IT | GDP WDA QoQ - Final | Actual > Forecast = Good for currency; |
| IT | GDP WDA QoQ - Preliminary | Actual > Forecast = Good for currency; |
| IT | Industrial Production WDA YoY | Actual > Forecast = Good for currency; |
| IT | Retail Sales MoM | Actual > Forecast = Good for currency; |
| IT | Total investments | Actual > Forecast = Good for currency; |
| IT | Trade Balance Total | Actual > Forecast = Good for currency; |
| IT | Unemployment Rate Quarterly | Actual < Forecast = Good for currency; |
| GE | Construction Investment QoQ | Actual > Forecast = Good for currency; |
| GE | Exports QoQ | Actual > Forecast = Good for currency; |

| | | |
|---|---|---|
| GE | Factory Orders WDA YoY -Preliminary | Actual > Forecast = Good for currency; |
| GE | GDP SA QoQ - Preliminary | Actual > Forecast = Good for currency; |
| GE | IFO Business Climate | Actual > Forecast = Good for currency; |
| GE | Imports QoQ | Actual > Forecast = Good for currency; |
| GE | Industrial Production SA MoM -Preliminary | Actual > Forecast = Good for currency; |
| GE | PPI MoM | Actual > Forecast = Good for currency; |
| GE | Private Consumption QoQ | Actual > Forecast = Good for currency; |
| GE | Retail Sales MoM | Actual > Forecast = Good for currency; |
| GE | Unemployment Rate | Actual < Forecast = Good for currency; |
| GE | ZEW Survey Current Situation | Actual > Forecast = Good for currency; |
| GE | ZEW Survey Expectations | Actual > Forecast = Good for currency; |
| FR | Consumer Spending (MoM) | Actual > Forecast = Good for currency; |
| FR | Own-Company Production Outlook | Actual > Forecast = Good for currency; |
| FR | PPI MoM | Actual > Forecast = Good for currency; |
| EC | Business Climate Indicator | Actual > Forecast = Good for currency; |
| EC | CPI Core YoY - Final | Actual > Forecast = Good for currency; |
| EC | CPI Estimate YoY | Actual > Forecast = Good for currency; |
| EC | ECB Announces Interest Rates | Actual > Forecast = Good for currency; |
| EC | GDP SA QoQ - Final | Actual > Forecast = Good for currency; |
| EC | Govt Expend QoQ - Preliminary | Actual > Forecast = Good for currency; |
| EC | Gross Fix Cap QoQ - Final | Actual > Forecast = Good for currency; |
| EC | Gross Fix Cap QoQ -Preliminary | Actual > Forecast = Good for currency; |
| EC | Household Cons QoQ -Preliminary | Actual > Forecast = Good for currency; |
| EC | Industrial New Orders SA (MoM) | Actual > Forecast = Good for currency; |
| EC | Industrial Production SA MoM | Actual > Forecast = Good for currency; |
| EC | Labour Costs YoY | Actual > Forecast = Good for currency; |
| EC | PMI Manufacturing -Preliminary | Actual > Forecast = Good for currency; |
| EC | Retail Sales MoM | Actual > Forecast = Good for currency; |
| EC | Trade Balance SA | Actual > Forecast = Good for currency; |
| EC | ZEW Survey Expectations | Actual > Forecast = Good for currency; |

# Appendix B: Description of the Speakers

In the following table, it shows the working position and the organization of the speakers.

| Speaker | Position | Organization |
|---|---|---|
| Ben Shalom Bernanke | Chairman of the Federal Reserve | Fed |
| Susan Bies | Board of Governors of the Federal Reserve | Fed |
| James B. Bullard | President of the Federal Reserve Bank of St. Louis | Fed |
| William C. Dudley | President of Federal Reserve Bank of New York | Fed |
| Elizabeth A. Duke | Board of Governors of the Federal Reserve | Fed |
| Charles Evans | President of Federal Reserve Bank of Chicago | Fed |
| Roger W. Ferguson | Vice Chairman of the Board of Governors of the Federal Reserve System | Fed |
| Richard W. Fisher | President of the Federal Reserve Bank of Dallas | Fed |
| Timothy Geithner | President of the Federal Reserve Bank of New York 2003-2009. Secretary of the Treasury from 2009 to 2013 | Fed/ Treasury |
| Edward M. Gramlich | Board of Governors of the Federal Reserve | Fed |
| Alan Greenspan | Chairman of the Federal Reserve from 1987 - 2006 | Fed |
| Jack Guynn | President and CEO of the Federal Reserve Bank of Atlanta | Fed |
| Thomas Michael Hoenig | President and CEO Federal Reserve Bank of Kansas City | Fed |
| Narayana Kocherlakota | President of the Federal Reserve Bank of Minneapolis | Fed |
| Donald Lewis Kohn | Vice Chairman of the Board of Governors of the Federal Reserve System | Fed |
| Randall Kroszner | Board of Governors of the Federal Reserve System | Fed |
| Jeffrey M. Lacker | President of the Federal Reserve Bank of Richmond | Fed |
| Dennis P. Lockhart | President and CEO of the Federal Reserve Bank of Atlanta | Fed |
| Frederic Mishkin | Board of Governors of the Federal Reserve System. 2006 to 2008 | Fed |
| Mark W. Olson | Board of Governors of the U.S. Federal Reserve.2001 to 2006 | Fed |
| Henry Paulson | Secretary of the Treasury from 2006 to 2009 | Treasury |
| Sandra Pianalto | President and chief executive officer of the Federal Reserve Bank of Cleveland | Fed |
| Charles Irving Plosser | president of the Federal Reserve Bank of Philadelphia | Fed |
| William Poole | Chief executive of the Federal Reserve Bank of St. Louis | Fed |
| Sarah Bloom Raskin | Board of Governors of the Federal Reserve System | Fed |
| Eric S. Rosengren | President and chief executive officer of the Federal Reserve Bank of Boston | Fed |

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|---|---|---|
| Anthony M. Santomero | President, Federal Reserve Bank of Philadelphia | Fed |
| John William Snow | Secretary of the Treasury | Treasury |
| Gary H. Stern | Chief executive of the Federal Reserve Bank of Minneapolis | Fed |
| Daniel Tarullo | Board of Governors of the United States Federal Reserve | Fed |
| Kevin Warsh | Board of Governors of the Federal Reserve System | Fed |
| John Williams | Chief executive of the Federal Reserve Bank of San Francisco | Fed |
| Janet Louise Yellen | Chief executive of the Federal Reserve Bank of San Francisco. 2004 to 2010. Vice Chair of the Board of Governors of the Federal Reserve System after 2010. | Fed |
| Andrew Bailey | Chief Cashier at the Bank of England | BoE |
| Charlie Bean | Deputy Governor at the Bank of England | BoE |
| Andy Haldane | Executive Director of Financial Stability at the Bank of England | BoE |
| Mervyn Allister King | Governor of the Bank of England and Chairman of its Monetary Policy Committee | BoE |
| Adam S. Posen | Member of the Monetary Policy Committee of the Bank of England | BoE |
| Paul Tucker | Deputy Governor of the Bank of England | BoE |
| Mark Joseph Carney | Governor of the Bank of England | |
| Fukui | Bank of Japan Governor | BOJ |
| Fukuma | Bank of Japan Board Member | BOJ |
| Ishida | Bank of Japan Board Member | BOJ |
| Iwata | Bank of Japan Deputy Governor | BOJ |
| Kiuchi | Bank of Japan Board Member | BOJ |
| Kuroda | Bank of Japan Governor | BOJ |
| Miyao | Bank of Japan Board Member | BOJ |
| Takeshita | Senior Strategist | Mizuho |
| Mizuno | Bank of Japan Board Member | BOJ |
| Morimo | Bank Of Japan Board Member | BOJ |
| Nakamu | Bank of Japan Board Member | BOJ |
| Nakaso | Bank of Japan Deputy Governor | BOJ |
| Vail | Chief Global Strategist and Head of the Investment Strategy Group | Nikko |
| Nishim | Bank of Japan Deputy Governor | BOJ |
| Nomine | Bank of Japan Deputy Governor | BOJ |
| Sato | Bank Of Japan Board Member | BOJ |
| Shirai | Bank of Japan Board Member | BOJ |
| Shirak | Bank of Japan Governor | BOJ |

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|---|---|---|
| Watana | Vice Finance Minister | Fin |
| Joaquin Almunia | European Economic and Monetary Affairs Commissioner | Eco |
| Joerg Asmussen | Member of the executive board of the European Central Bank | ECB |
| Jaime Caruana | Member of the Governing Council of the European Central Bank. | ECB |
| Benoit Cœuré | Member of the executive board of the European Central Bank | ECB |
| Vítor Constâncio | Vice-President of the ECB | ECB |
| Andreas Dombret | Bundesbank board member | GE |
| Mario Draghi | President of the ECB | ECB |
| José Manuel González-Páramo | Member of the ECB's Executive Board | ECB |
| John Hurley | Member of the Governing Council of the European Central Bank | ECB |
| Otmar Issing | Member of the Board of the European Central Bank | ECB |
| Klaus Liebscher | Member of the Governing Council of the European Central Bank | ECB |
| Erkki Liikanen | Member of the Governing Council of the European Central Bank | ECB |
| Yves Mersch | Member of the executive board of the European Central Bank | ECB |
| Ewald Nowotny | Member of the European Central Bank (ECB)'s governing council | ECB |
| Christian Noyer | Governor of the Bank of France | GE |
| Miguel Angel Fernandez Ordonez | Member of the Governing Council of the European Central Bank | ECB |
| Athanasios Orphanides | Member of the Governing Council of the European Central Bank | ECB |
| Lucas Papademos | Vice President of the European Central Bank | ECB |
| Peter Praet | Member of the executive board of the European Central Bank | ECB |
| Guy Quaden | Member of the Governing Council of the European Central Bank | ECB |
| Lorenzo Bini Smaghi | Member of the Executive Board of the European Central Bank | ECB |
| Juergen Stark | Member of the Executive Board of the European Central Bank | ECB |
| Jean-Claude Trichet | President of the European Central Bank | ECB |
| Gertrude Tumpel-Gugerell | Member of the Executive Board of the European Central Bank | ECB |
| Axel A. Weber | Member of the executive board of the European Central Bank | ECB |
| Jens Weidmann | President of the Bundesbank | GE |
| Nout Wellink | Board of Directors | ECB |